1998-2005 ENGINE

Electrical System - Engine - 163 Chassis

GENERAL INFORMATION

GENERAL NOTES: PASSENGER CARS: ELECTRICAL SYSTEM - ENGINE - AH15.00-Z-9999AZ

MODEL all

	General notes on contactless high voltage distribution	ENGINE 112, 113...	**AH15.10-P-1002-01WA**
	General notes on contactless high voltage distribution	ENGINE 104, 111...	AH15.10-P-1002-01WD
	General notes on contactless high voltage distribution	ENGINE 119, 120...	AH15.10-P-1002-01WE
	General notes on testing contactless high voltage distribution	ENGINE 104, 111, 112, 113, 119, 120...	**AH15.10-P-1003-01W**
	Notes on ignition coil characteristics of ignition systems	ENGINE 104, 111, 112, 113, 119, 120...	**AH15.10-P-1001-01A**
Danger!	Notes on avoiding damage to ignition system	ENGINE 266.920 /940 /960 /980 in MODEL 169.0/3,245.2	AH15.10-P-0002-01AK
Danger!	Notes on avoiding damage to the ignition system	ENGINE 111 mit Benzin-Einspritz-und Zundsystem PMS	AH15.10-P-0002-01B
Danger!	Notes on avoiding damage to the ignition system	ENGINE 104, 111 mit Benzin-Einspritz-und Zundsystem HFM	AH15.10-P-0002-01C
Danger!	Notes on avoiding damage to the ignition system	ENGINE 103, 104, 119 mit Benzin-Einspritzanlage KE	AH15.10-P-0002-01E
Danger!	Notes on avoiding damage to the ignition system	ENGINE 104, 119, 120 mit Benzin-Einspritzanlage LH	AH15.10-P-0002-01F
Danger!	Notes on avoiding damage to the ignition system	ENGINE 166 mit Benzin-Einspritz- und Zundsystem MSM	AH15.10-P-0002-01G
Danger!	Information on avoiding damage to ignition system	ENGINE 137, 275, 285	AH15.10-P-0002-01L
Danger!	Notes on avoiding	ENGINE 272, 273	AH15.10-P-0002-01V

	damage to ignition system		
⚠ Danger!	Notes on avoiding damage to ignition system	ENGINE 104, 111, 112, 113, 119, 120, 156, 271, 112 mit Benzin-Einspritz- und Zundsystem ME	**AH15.10-P-0002-01D**
⚠ Danger!	Notes for ceramic glow plugs	ENGINE 646.8, 642	AH15.20-P-0001-01A

NOTES ON AVOIDING DAMAGE TO IGNITION SYSTEM - AH15.10-P-0002-01D

Engine 104, 111, 112, 113, 119, 120, 156, 271

- To avoid damage to control unit connect and disconnect the two connectors on control unit only when ignition is switched off.
- Terminal 1 of ignition coils must not be short-circuited to GND, e.g. as anti-theft protection.
- Install only original ignition system components.
- Do not operate ignition system at starting speed unless all of the ignition cables are connected.
- No tests such as holding ignition cable 4 at a distance to GND, unplugging a spark plug connector or pulling cable 4 out of the ignition coils, may be performed at starting speed or when the engine is running.
- Every high voltage circuit must be loaded with at least 2 kohms (spark plug connector).
- If it is necessary to test the ignition spark when providing roadside assistance, this must only be done with a spark plug at a cylinder ignition cable. Ensure that the spark plug has good contact to ground.
- Before working at cranking speed, e.g. checking compression pressure, switch off ignition and disconnect connector "2" from control unit.

Engine 120 has two fuel injection and ignition systems.

Use of testers

- Only connect and disconnect secondary measuring sensor to corresponding ignition cables when vertical engine and ignition are switched off.
- If the shot-circuit protection is operated (cylinder comparison) and the engine stays upright, it is not possible to conduct the test with this test instrument.
- Do not connect test lamp to ignition coil terminals 1 and 15.

NOTES ON IGNITION COIL CHARACTERISTICS OF IGNITION SYSTEMS - AH15.10-P-1001-01A

Engine 104, 111, 112, 113, 119, 120

In the case of the twin-spark ignition coil with kV pickup in ignition systems ME-SFI 2.1 and HFM-SFI, no measurement facility exists at the ignition coil using the kV pickup although a kV pickup is fitted. It is only

possible to test the primary ignition circuit with adapter cable A.

Ignition coil characteristics of ignition systems

Engine	Model	HFM-SFI	ME-SFI	PEC	Twin-spark ignition coil without kV pickup	Twin-spark ignition coil with kV pickup	Single-spark ignition coil with kV pickup
104	129 up to 05/96	X			X		
104	129 as of 06/96		2.1			X	
104	140 up to 05/96	X			X		
104	140 as of 06/96		2.1			X	
104	202 up to 07/96	X			X		
104	202 as of 08/96		2.1			X	
104	210	X			X		
104	210 Nm J up to 05/96	X			X		
104	210 Nm J as of 06/96		2.1			X	
111	163	X				X	
111	170.435	X				X	
111	170.445		2.1			X	
111	170.447		2.1			X	
111	202.018/020 up to 07/96			X	X		
111	202.018/020 as of 08/96	X				X	
111	202.025 up to 07/96	X			X		
111	202.025 as of 08/96		2.1			X	
111	202.022 up to 07/96	X			X		
111	202.023 as of 08/96	X				X	
111	202.023 as of 08/96 Nm		2.1			X	
111	202.024 up to 07/96	X			X		
111	202.024 as of 08/96		2.1			X	
111	210 up to 05/96	X			X		
111	210 as of 06/96	X				X	

112	163		2.0			X	
112	202		2.0			X	
112	208		2.0			X	
112	210		2.0			X	
112	220		2.0			X	
113	163		2.0			X	
113	202		2.0			X	
113	208		2.0			X	
113	210		2.0			X	
113	220		2.0			X	
119.982	129		1.0				X
119.980	140		1.0				X
119.981	140		1.0				X
119	210		1.0				X
120.983	129		1.0				X
120.982	140		1.0				X

GENERAL NOTES ON CONTACTLESS HIGH VOLTAGE DISTRIBUTION - AH15.10-P-1002-01WA

Engine 112, 113 with ME-SFI fuel injection and ignition system

The ignition system can be tested at the primary side and secondary side. It is only possible to test ignition circuit a and ignition circuit b one after the other.

The ignition coils are fitted as standard with cast mounts for the secondary adapters (kV pickup C). The primary ignition voltage curve can be plotted with a primary adapter cable (D).

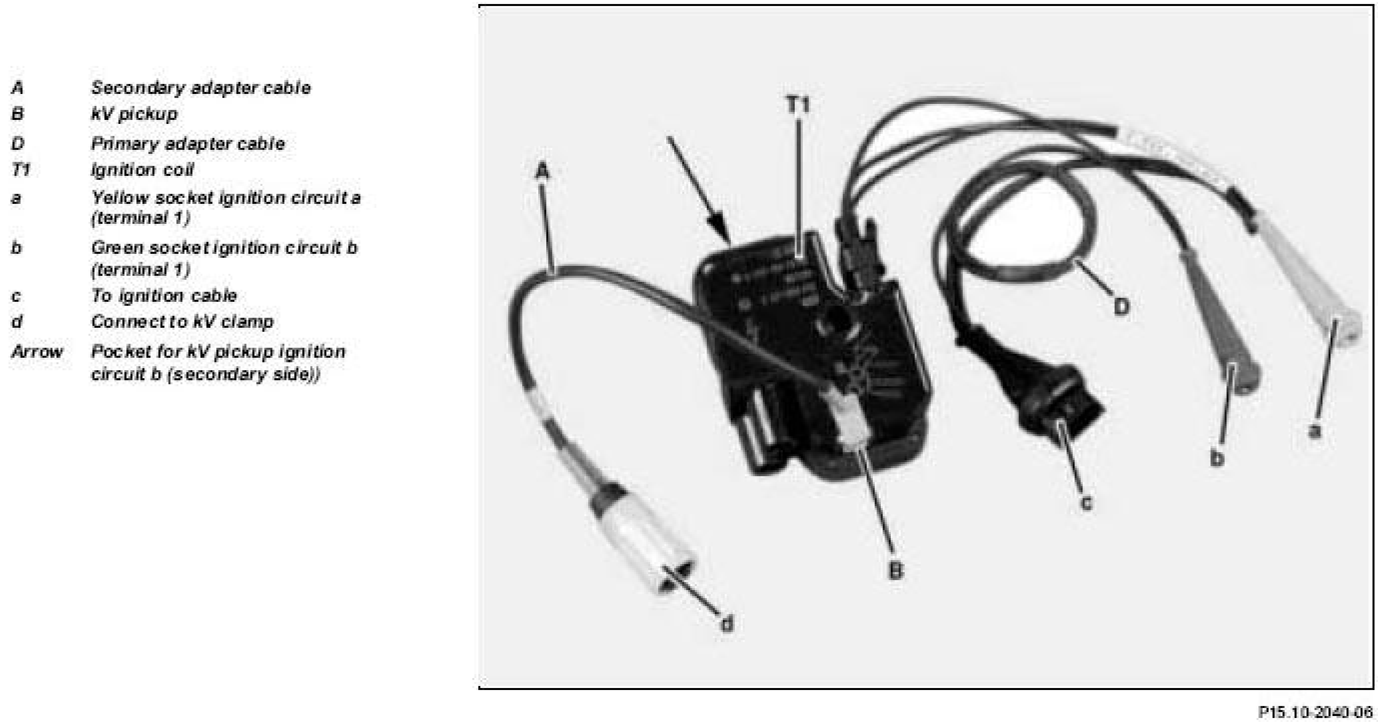


Fig. 1: Identifying Connection Cables Of Double Ignition Coil

Diagnosis with engine tester:

Connect green connector (terminal 1) of engine tester alternatively to the yellow socket or green socket for assessing an ignition circuit with the primary adapter cable.

Connect yellow connector (terminal 15) of engine tester to positive (tml. 30 /tml. 15).

GENERAL NOTES ON TESTING CONTACTLESS HIGH VOLTAGE DISTRIBUTION - AH15.10-P-1003-01W

If a complaint exists in the start or warming-up phase, do not condition engine to operating temperature but proceed on a complaint-related basis.

Connections: set diagnostic tester to cylinder number 1 primary or secondary (if possible) and test through the ignition circuits one after the other.

Diagnosis test oscilloscope / good image contactless high voltage distribution Secondary side (single image) Engine idling

(shown on engine M119.981, cylinder 1 with Bosch ignition coil)

Measuring range: 40 kV

Time range: 5 ms

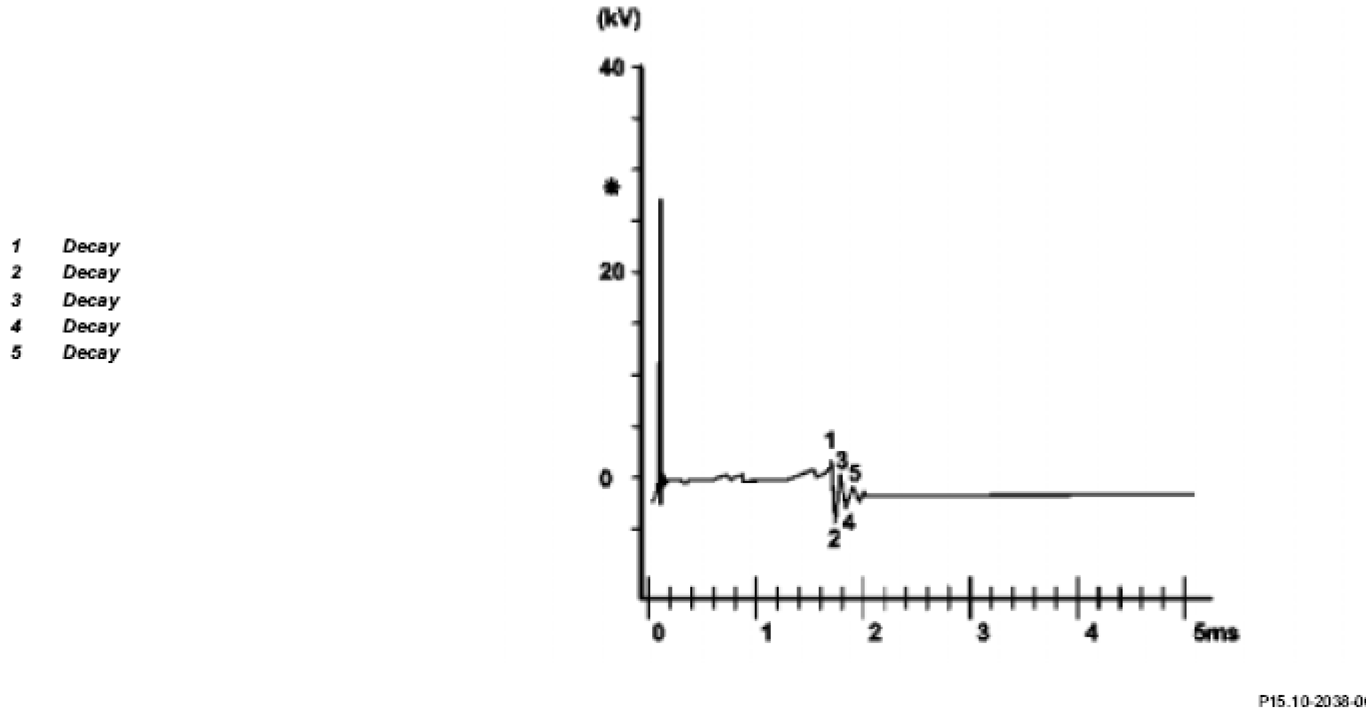


Fig. 2: Diagnosis Test Oscilloscope / Good Image Contactless High Voltage Distribution Secondary Side (Single Image) Engine Idling

Diagnosis test oscilloscope / good image contactless high voltage distribution Primary side (single image) Engine idling

(shown on engine M119.981, cylinder 1)

Meauring range: 40 V

Time range: 5 ms

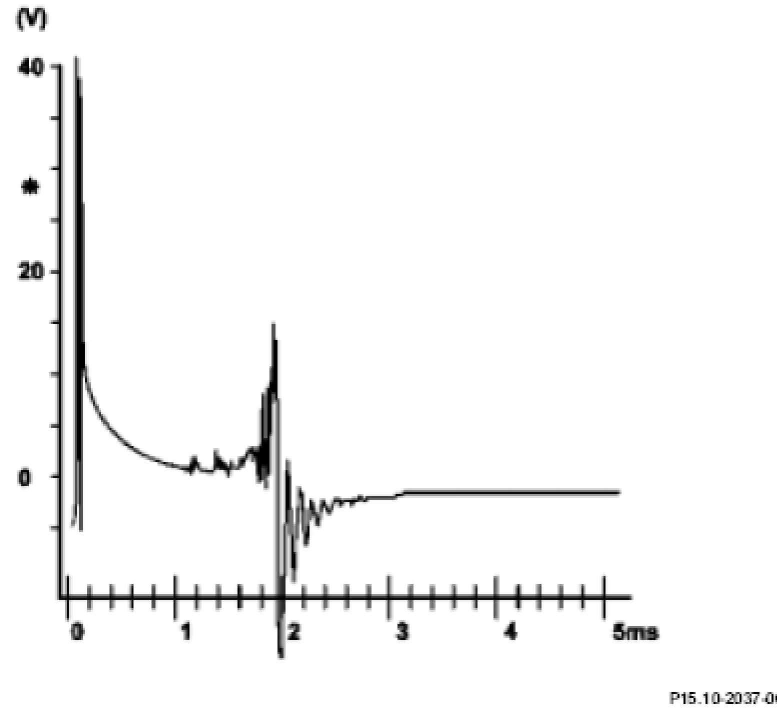


Fig. 3: Diagnosis Test Oscilloscope / Good Image Contactless High Voltage Distribution Primary Side (Single Image) Engine Idling

BASIC KNOWLEDGE

SPARK PLUGS, LOCATION/TASK/DESIGN/FUNCTION - GF15.10-P-3101F

ENGINE 104, 111, 112, 113/, 119, 120, 137, 166 (except, 112.96, 113.98/99)

R4 *Spark plugs*



Fig. 4: Identifying Spark Plug

	Spark plugs, location	One or two spark plugs are located in the cylinder head per cylinder.	
	Spark plugs, task	The spark plugs ignite the suctioned and compressed fuel-air mixture due to arcing between the electrodes.	
	Spark plugs, design	In the manufacturer's specific type symbols, all the spark plug features are assigned (e. g. heat rating, shape of seating, thread, width across flats, electrode material, spark position).	
	Spark plugs, function	The ignition voltage travels to the spark plugs from directly connected ignition coils or over the ignition lines from the ignition coils causing arcing in the air gap between the center and ground electrodes.	

IGNITION COILS, LOCATION - GF15.10-P-3102-01A

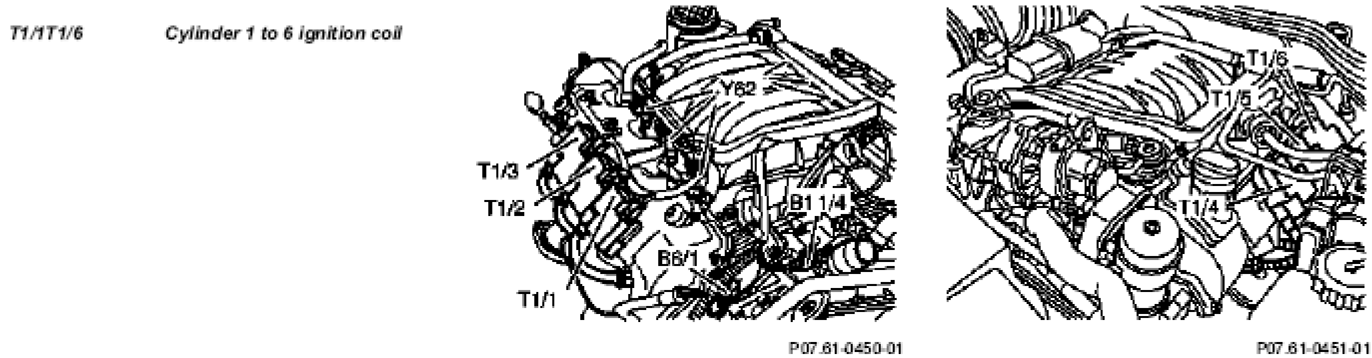


Fig. 5: Identifying Cylinder 1 To 6 Ignition Coil - Location On Engine 112

T1/1T1/8 Cylinder 1 to 8 ignition coil

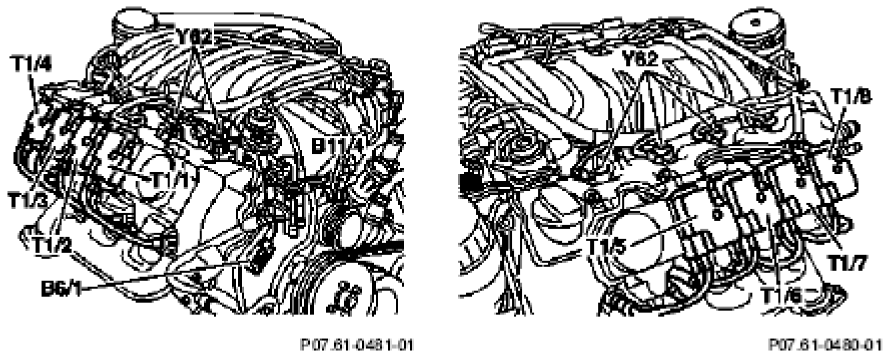


Fig. 6: Identifying Cylinder 1 To 8 Ignition Coil - Location Engine 113

IGNITION COILS, FUNCTION - GF15.10-P-3102-02A

Each spark plug is actuated separately via its own ignition coil by the ME control unit. Both ignition coils of a cylinder are combined to form a dual ignition coil.

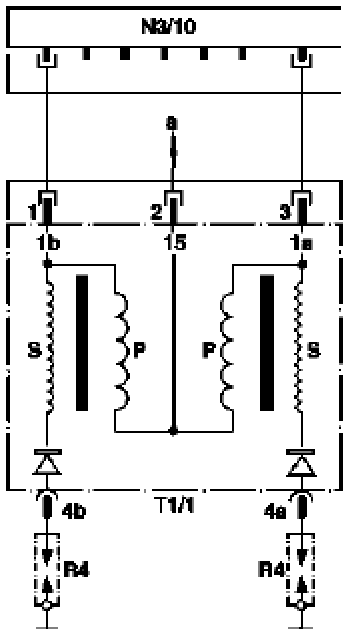
The ME control unit actuates the primary wirings (L1) of the double ignition coils at circuits 1 a or 1 b with ground.

The primary current flow is interrupted at the moment of ignition timing point. As a result of the sudden collapse of the magnetic field the ignition voltage is generated in the secondary windings (L2). The ignition voltage flows through the high voltage connection (4a and 4b) and through the spark plug connector to the respective spark plug (R4).

The voltage supply of the double ignition coils is protected at circuit 15 (a).

Diodes are built-in to suppress additional ignition sparks when the primary current is switched on.

Because of the diodes, it is not possible to measure the resistance in the secondary windings.



P15.10-0230-03

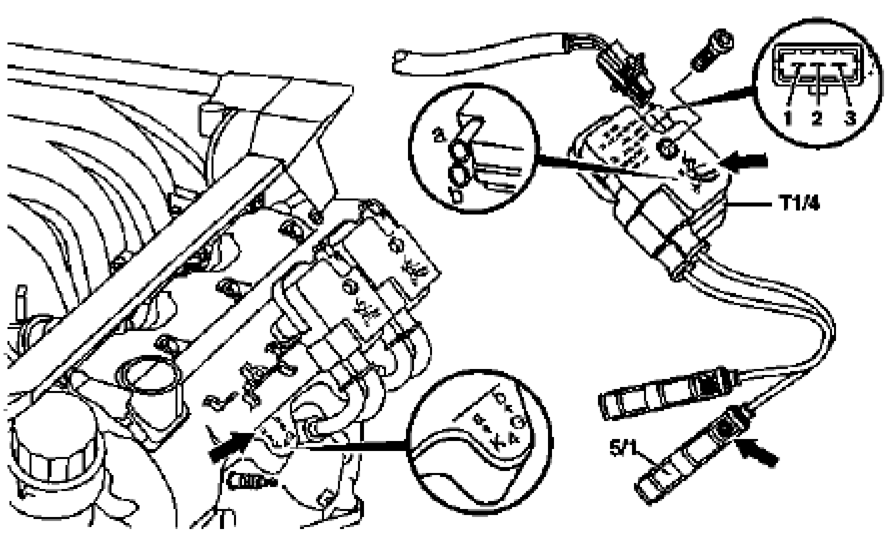
Fig. 7: Identifying Ignition Coils, Function

IGNITION COILS, LOCATION/TASK/DESIGN/FUNCTION - GF15.10-P-3102A

ENGINE
112.910 /911 /912 /913 /914 /916 /917 /920 /921 /922 /923 /940 /941 /942 /943 /944 /946 /947 /949 /953 /954 /9

ENGINE 113.940 /941 /942 /943 /948 /960 /961 /963 /965 /966 /967 /968 /969

5/1	*Spark plug connector*
T1/4	*Ignition coil cylinder 4*
	(Dual ignition coil)
	3-pin connector
	1 Circuit 1b
	2 circuit 15 fused
	3 Circuit 1a
	A, B High voltage connection
Arrows	*Assignment of high voltage connection/ spark plug connector/ cylinder*

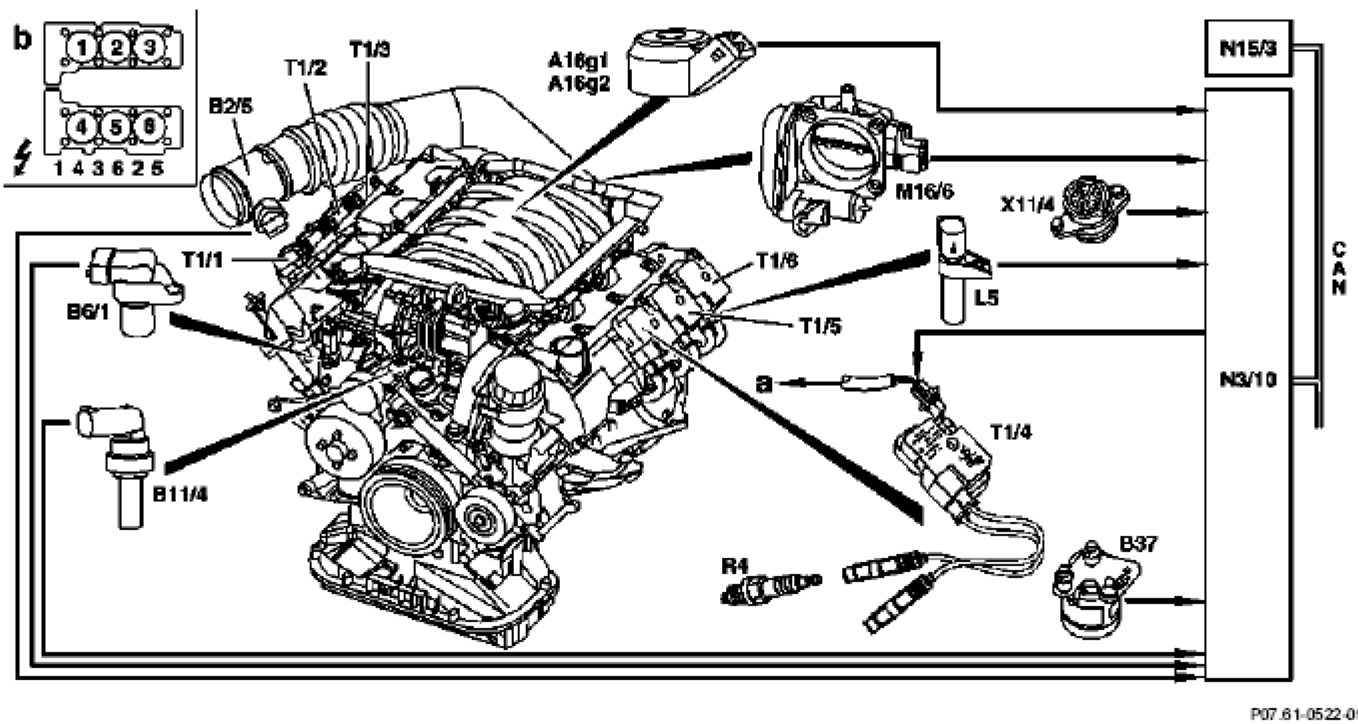


P15.10-0231-05

Fig. 8: Identifying Ignition Coil Components - Shown On Engine 112

	Ignition coils, location		**GF15.10-P-3102-01A**
	Ignition coils, task	Supplying adequate ignition energy in all operating conditions for the particular ignition circuit.	
	Ignition coils, design	One double ignition coil for each cylinder. Attached to cylinder head cover.	
	Ignition coils, function		**GF15.10-P-3102-02A**

ME-SFI IGNITION SYSTEM FUNCTION DIAGRAM - GF15.12-P-0001-01A

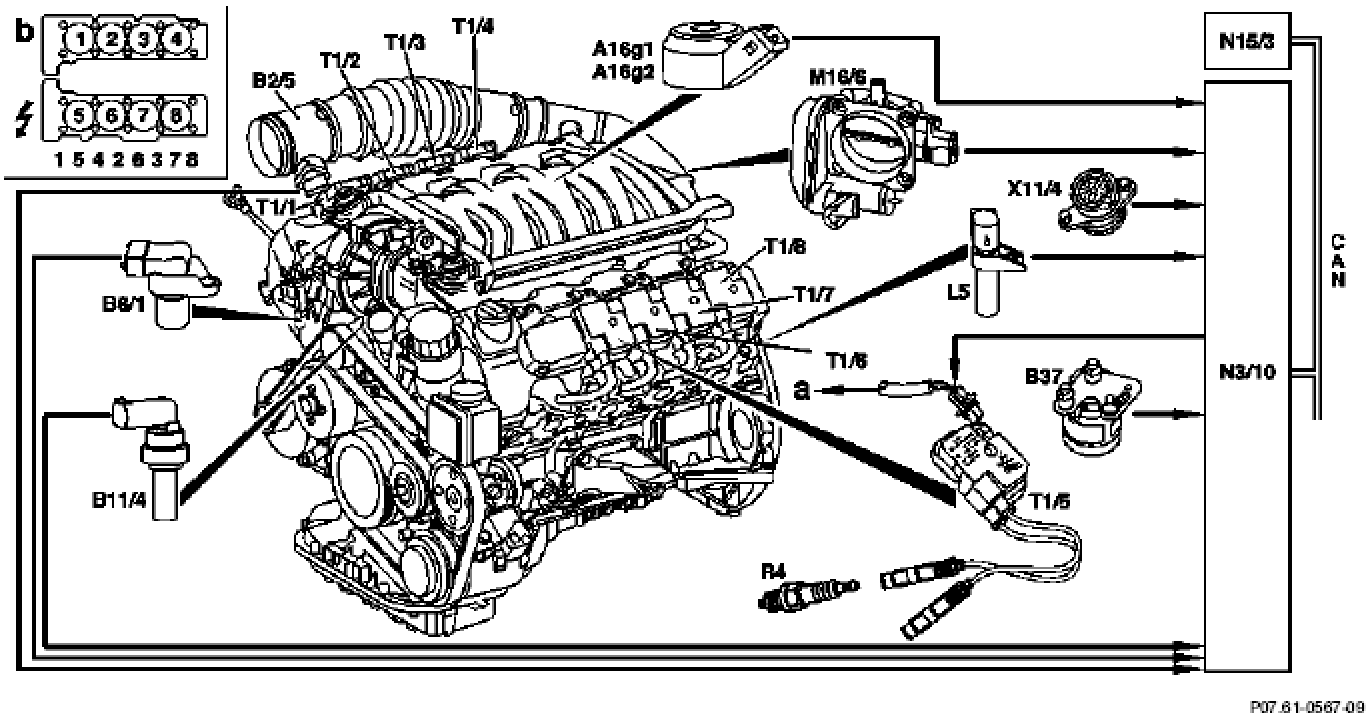


Basic diagram of ignition system with rotorless high voltage distribution, engine 112

A16G1	Knock sensor 1 (right side of engine)	B11/4	Coolant temperature sensor	T1/1-T1/6	Ignition coils, cylinders 1 to 6 (double ignition coils)
A16G2	Knock sensor 2 (left side of engine)	B37	Accelerator pedal sensor	X11/4	Datalink connector 38-pin or 16-pin
B2/5	Hot film mass air flow sensor (intake air temperature sensor integrated)	L5	Crankshaft position sensor	A	circuit 15 fused
B6/1	Camshaft Hall sensor	M16/6	Throttle valve actuator	B	Arrangement of cylinders, firing order
		N3/10	ME-SFI [ME] control unit	CAN	Data bus
		N15/3	ETC (electronic transmission control) control unit		
		R4	Spark plugs		

Fig. 9: Identifying ME-SFI Ignition System Components - Engine 112

ME-SFI IGNITION SYSTEM FUNCTION DIAGRAM - GF15.12-P-0001-01B



Basic diagram of ignition system with rotorless high voltage distribution, engine 113

A16G1	Knock sensor 1 (right side of engine)
A16G2	Knock sensor 2 (left side of engine)
B2/5	Hot film mass air flow sensor (intake air temperature sensor integrated)
B6/1	Camshaft Hall sensor
B11/4	Coolant temperature sensor
B37	Accelerator pedal sensor
L5	Crankshaft position sensor
M16/6	Throttle valve actuator
N3/10	ME-SFI [ME] control unit
N15/3	ETC (electronic transmission control) control unit)
R4	Spark plugs
T1/1- T1/8	Ignition coils, cylinders 1 to 8 (double ignition coils)
X11/4	Datalink connector 38-pin or 16-pin
A	circuit 15 fused
B	Arrangement of cylinders, firing order
CAN	Data bus

Fig. 10: Identifying ME-SFI Ignition System Components - Engine 113

ME-SFI IGNITION SYSTEM SIGNAL ASSIGNMENT - GF15.12-P-0001-02A

1 Crank angle
2 Cylinder ignition TDC
3 Signal from crankshaft position sensor (L5)
4 Signal from camshaft Hall sensor (B6/1)
5 Speed signal TNA

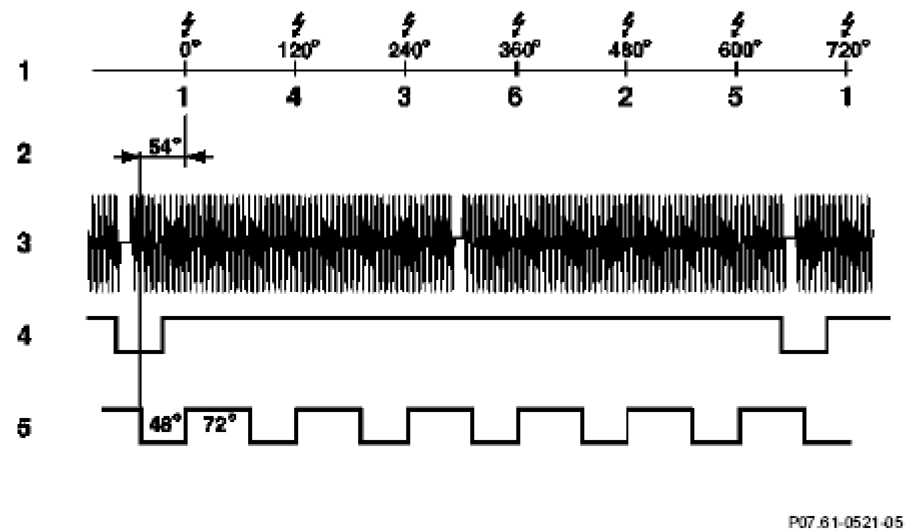


Fig. 11: Identifying ME-SFI Ignition System Signal Assignment - Signal Assignment Engine 112

ME-SFI IGNITION SYSTEM SINGLE ASSIGNMENT - GF15.12-P-0001-02B

1 Crank angle
2 Cylinder ignition TDC
3 Signal from crankshaft position sensor (L5)
4 Signal from camshaft Hall sensor (B6/1)
5 Rpm signal TNA Recognition of cylinder 1

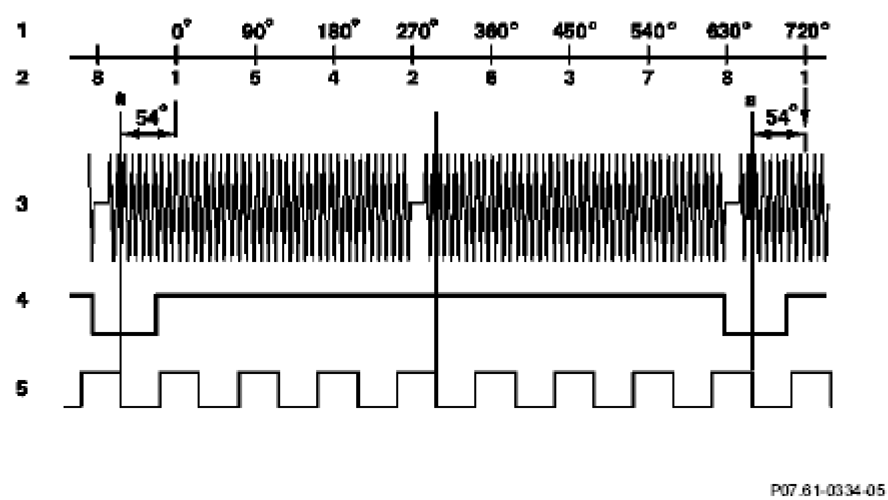


Fig. 12: Identifying ME-SFI Ignition System Signal Assignment - Signal Assignment Engine 113

TNA rpm signal on ME2.8 with 3 pulses for each engine revolution

ME-SFI IGNITION SYSTEM FUNCTION - GF15.12-P-0001F

ENGINE 104.941 /943 /944 /991 /994 as of 1.8.96

ENGINE 104.995

with CODE (494a) USA version

with CODE (807) Model year 1997

with CODE (808) Model year 1998

with CODE (498) as of Model Year 97 Japanese version

ENGINE 111.921 /942 as of 1.9.98,

111.943,

111.944 as of 1.8.96,

111.946 as of 1.6.98,

111.947/973,

111.975 as of 1.8.96

ENGINE 111.945

in MODEL 208.335 /435 as of 1.6.98,

202.020/080 as of 1.9.98

ENGINE 111.974

with CODE (494a) USA version

with CODE (807) Model year 1997

with CODE (808) Model year 1998

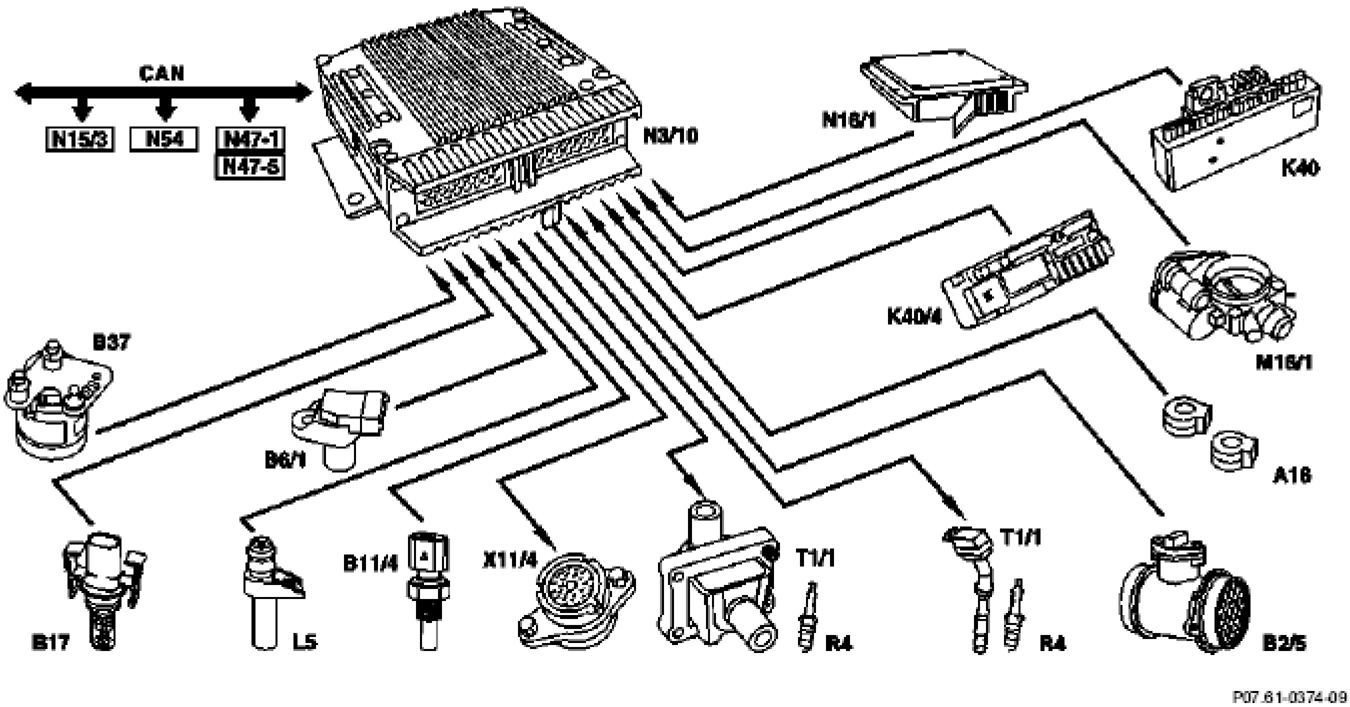
ENGINE
112.910 /911 /912 /913 /914 /916 /917 /920 /921 /922 /923 /940 /941 /942 /943 /944 /946 /947 /949 /953 /954 /9

ENGINE 113.940 /941 /942 /943 /948 /960 /961 /963 /965 /966 /967 /968 /969

ENGINE 119.980 /981 /982 /985

ENGINE 120.982/983

ENGINE 137.970



Example of ME-SFI ignition system

A16	*Knock sensors*
B2/5	*Hot film mass air flow sensor*
B6/1	*Camshaft Hall sensor*
B11/4	*Coolant temperature sensor*
B17	*Intake air temperature sensor (on engine 104, 111, 112, 113 integrated in hot film mass air flow sensor)*
B37	*Accelerator pedal sensor*
K40	*Relay module model 170, 210 up to 2/97*
K40/4	*Fuse and relay module Model 202, 208, Model 210 as of 3/97, Model 163 designation F1*
L5	*Crankshaft position sensor*
M16/1	*Electronic accelerator EA/CC/ISC actuator*
N3/10	*ME-SFI [ME] control unit*
N15/3	*ETC [EGS] control unit*
N16/1	*Base module model 129, 140*
N47-1	*ASR/SPS control unit*
N47-5	*ESP / SPS [PML] / BAS control unit*
N54	*RCL control unit*
R4	*Spark plugs*
T1/1	*Ignition coils Engine 104, 111: a two-spark ignition coil for two cylinders Engine 119, 120: one ignition coil for each cylinder Engine 112, 113: a double ignition coil for each cylinder*
X11/4	*Data link connector*
CAN	*Data bus*

Fig. 13: Identifying ME-SFI Ignition System Components

Signal assignment

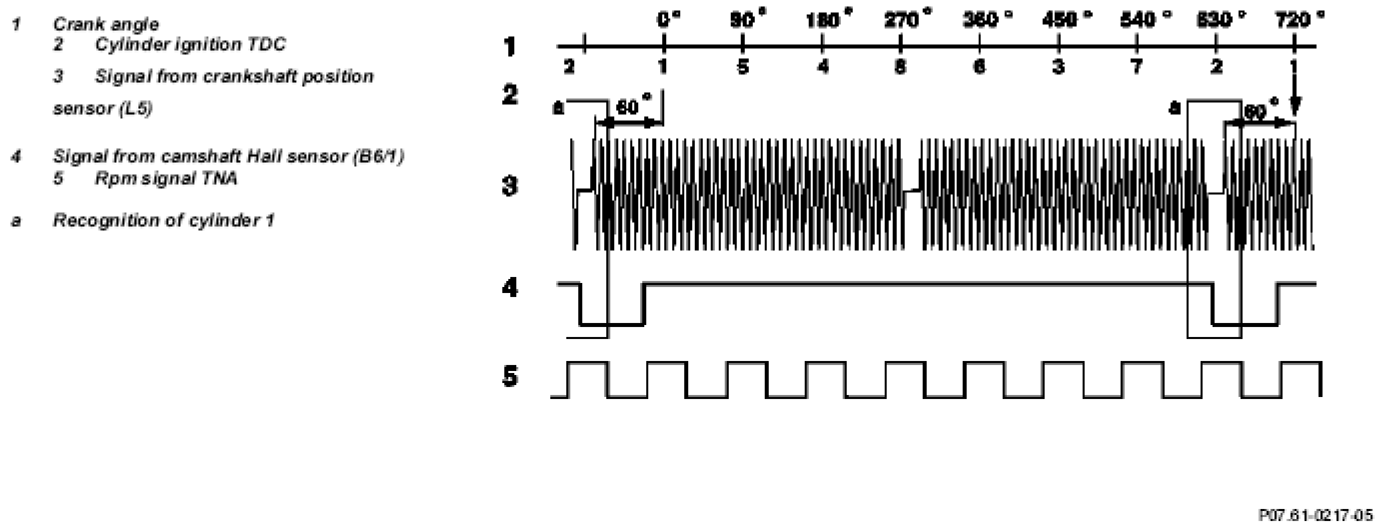


Fig. 14: Identifying Signal Assignment - Shown On Engine 119

Function

When the crankshaft is rotating, an alternating voltage is generated in the crankshaft position sensor by the teeth of the driven plate. In this case, each tooth generates an alternating voltage signal. No voltage is generated through the gap of 2 missing teeth. The ME-SFI control unit detects the TDC position of the crankshaft with the 2nd negative slope after the gap.

Engine	Recognition of TDC position of cylinder	Ignition TDC
111	1 and 4	Cylinder 1
104, 112, 113, 119	1 and 6	Cylinder 1
120, 137	Right hand cylinder bank: 1 and 6 Left cylinder bank: 7 and 12	Cylinder 1 Cylinder 7

If the signal from the camshaft Hall sensor is at 0 V ("low") at this moment, the ME control unit processes this in order to detect ignition TDC. This, is used for actuating the ignition coils and the fuel injectors. The high voltage is distributed rotorlessly. Advantages of the rotorless high voltage distribution are:

- significantly reduced electromagnetic interference level (no naked sparks)
- no rotating parts
- reduction in noise
- reduced high voltage connections.

1. **Determine ignition angle according to input signals, actuate ignition coils and release ignition spark.**

   The ME-SFI control unit essentially analyzes the following signals for determining the ignition angle:

- Engine load
- Crankshaft position sensor
- Camshaft Hall sensor
- Coolant temperature sensor
- Intake air temperature sensor/charge air.

Coil ignition: The ME control unit interrupts at the point of ignition timing at the ground end the ignition coil primary circuit of the ignition coil.

ECI ignition system (engine 137): The ME control unit actuates the output stages in the ECI ignition modules.

The ignition angle can only be checked with the HHT/STAR DIAGNOSIS.

2. **Ignition angle adaptation**

2.1 Catalytic converter heating-up (warming-up)

The ignition angle is continuously retarded for about 20 seconds in order to more rapidly warm up the catalytic converter to its operating temperature if:

- coolant temperature at start > 15 °C and < 40 °C
- Selector lever position P or N

At the same time idle speed is increased by the idle speed control.

2.2 Idle speed

To assist the idle speed control, the ignition angle can be retarded by as much as 36° crank angle or advanced by as much as 20° crank angle.

Altering the ignition angle provides a more rapid control than altering the position of the throttle valve (idle speed control).

2.3 Deceleration fuel shutoff

The ignition angle is briefly retarded when combustion is resumed (fuel injectors actuated) in order to prevent a sudden increase in torque.

2.4 Intake air temperature/coolant temperature

The ignition angle is retarded under load, as a function of the intake air temperature and coolant temperature, in order to prevent any knocking tendency at high intake air and coolant temperatures. The ignition angle is

"Retarded" if:

- Intake air temperature > 35 °C
- Coolant temperature > 105 °C

In supercharged engines the charge air temperature is used as information for the ignition timing adjustment in place of the intake air temperature.

The values of the retardation of the ignition angle of intake air temperature and coolant temperature are added together.

2.5 Transmission overload protection

In order to protect the shift elements of the automatic transmission during power shifts (1-2-1, 2-3-2) from excessive thermal stresses, the ignition angle is briefly retarded during the gearshift and the engine torque reduced as a result. The ME-SFI control units are supplied with a signal for this purpose from the ETC control unit (N15/3) over the CAN databus.

2.6 ESP/ASR control mode

In order to reduce the engine torque as rapidly as possible in the ESP/ ASR control mode, the ignition angle is retarded by the throttle valve actuator (opening angle reduced) prior to the control mode being activated. The information from the ESP/ASR control unit is supplied over the CAN databus to the ME-SFI control unit.

2.7 Anti-knock control (AKC)

If uncontrolled combustion (knocking) occurs at one or several cylinders, the ignition angle at the relevant cylinder or cylinders is "Retarded".

2.8 Smooth engine running analysis

To restrain the three way catalytic converter from thermal overload through combustion misfiring and in order to keep the exhaust emission values, the smooth operation of the engine is continuously monitored.

If combustion misfiring is identified at one or several cylinders, the corresponding fuel injection valves are no longer actuated after a certain number of misfires.

Engine 104, 111, 112, 113, 119, 120: Smooth operation evaluation is performed through the signals of the crankshaft position sensor.

Engine 137: Identification of combustion misfiring by means of ionic current signal, see ECI ignition system function.

2.9 Double ignition engine 112,113,137

Two spark plugs for each cylinder are beneficial because of the arrangement of the valves for achieving optimal emission levels and smooth engine running.

Each spark plug is actuated separately by the ME-SFI control unit through its own ignition coil. On engine 112, 113 both ignition coils of a cylinder are combined to form a dual ignition coil.

In the lower part load range up to approx. 2000 rpm both ignition sparks of a cylinder are triggered simultaneously. At moderate and high engine loads, the ignition sparks are triggered offset by as much as 10° crank angle. In this case, the sequence of actuation is constantly varied in order to achieve a uniform wear of both spark plugs and to avoid deposits on only one side of the combustion chamber.

For troubleshooting in the dual ignition system, it is possible to switch off one ignition circuit each with HHT or STAR DIAGNOSIS.

	ME-SFI ignition system function diagram	Engine 104 Engine 111 Engine 112 Engine 113 Engine 119 Engine 120	GF15.12-P-0001-01D GF15.12-P-0001-01G **GF15.12-P-0001-01A** **GF15.12-P-0001-01B** GF15.12-P-0001-01E GF15.12-P-0001-01F
	ME-SFI control unit position/task/design/ function		**GF07.61-P-5000F**
	ECI ignition system function	Engine 137	GF15.15-P-3000L
	Ignition coils, location/task/design/function	Engine 119, 120 Engine 104, 111 Engine 112, 113	GF15.10-P-3102F GF15.10-P-3102G **GF15.10-P-3102A**
	Crankshaft position sensor, location/task/ design/function		**GF07.04-P-4116F**
	Camshaft Hall sensor, location/task/design/ function		**GF07.04-P-4117F**
	Spark plugs, location/task/design/function		**GF15.10-P-3101F**
	Intake air temperature sensor, location/task/ design/function		**GF07.04-P-2100F**
	Hot film mass air flow sensor, location/task/ design/function	Engine 119, 120 (round connector) Engine 104, 111, 112, 113, 137	GF07.07-P-4118E **GF07.07-P-4118G**
	Coolant temperature sensor, location/task/ design/function	Engine 104, 111 Engine 112, 113, 137 Engine 119, 120	GF07.04-P-5026G **GF07.04-P-5026A** GF07.04-P-5026F
	Electronic accelerator,	Engine 104, 111, 112,	**GF30.20-P-3010E**

	location/design/function	113, 119, 137 Engine 120	 GF30.20-P-3010F
	Anti-knock control function		**GF15.12-P-4024F**
	Transmission overload protection function	with automatic transmission	**GF07.61-P-4026F**
	Overheating/pinging protection function		**GF07.61-P-4027F**
	Intake air temperature correction function		**GF07.61-P-4028F**
	ME-SFI synchronizing fuel injection and firing order function		**GF07.61-P-4009F**
	ME-SFI ignition system signal assignment	Engine 104 Engine 111 Engine 112 Engine 113 Engine 119 Engine 120 Engine 137	GF15.12-P-0001-02D GF15.12-P-0001-02G **GF15.12-P-0001-02A** **GF15.12-P-0001-02B** GF15.12-P-0001-02E GF15.12-P-0001-02F GF15.12-P-0001-02L
	ME engine speed signal function		**GF07.61-P-3017F**
	ASR V control unit location/task/design/function	with code 471a Model 129, 140, 202 as of 6/94, 170, 208, 210	GF42.40-P-4500A
	ESP control unit location / task / function	with code 472a Model 129 with engines 104, 119, 120 Model 140 Model 210 with engine 119 with code 472a Model 129 with engine 112, 113 Model 163 up to 8/02, 168, 215 Model 220 (except 220.08/18) Model 202, 208 with engine 112, 113 Model 210 with engine 111, 112, 113 with code 472a Model 170 with engines 111, 112 Model 202, 208 with Engine 111 Model 203	GF42.45-P-4500A **GF42.45-P-4500B** GF42.45-P-4500C

		Model 211, 230	GF42.45-P-4500SL
	ETC control unit, location/task	Transmission 722.6	**GF27.19-P-4012G**

ANTI-KNOCK CONTROL FUNCTION - GF15.12-P-4024F

ENGINE 104.941 /943 /944 /991 /994 as of 1.8.96

ENGINE 104.995

with CODE (494a) USA version

with CODE (807) Model year 1997

with CODE (808) Model year 1998

with CODE (498) as of Model Year 97 Japanese version

ENGINE 111.921 /942 as of 1.9.98,

111.943,

111.944 as of 1.8.96,

111.946 as of 1.6.98,

111.947/973,

111.975 as of 1.8.96

ENGINE 111.945

in MODEL 208.335 /435 as of 1.6.98,

202.020/080 as of 1.9.98

ENGINE 111.974

with CODE (494a) USA version

with CODE (807) Model year 1997

with CODE (808) Model year 1998

ENGINE 111.951 /952 /955 /956 /957 /958 /982 /983

ENGINE

112.910 /911 /912 /913 /914 /916 /917 /920 /921 /922 /923 /940 /941 /942 /943 /944 /946 /947 /949 /953 /954 /9

ENGINE 113.940 /941 /942 /943 /948 /960 /961 /963 /965 /966 /967 /969

ENGINE 119.980 /981 /982 /985

ENGINE 120.982/983

ENGINE 137.970

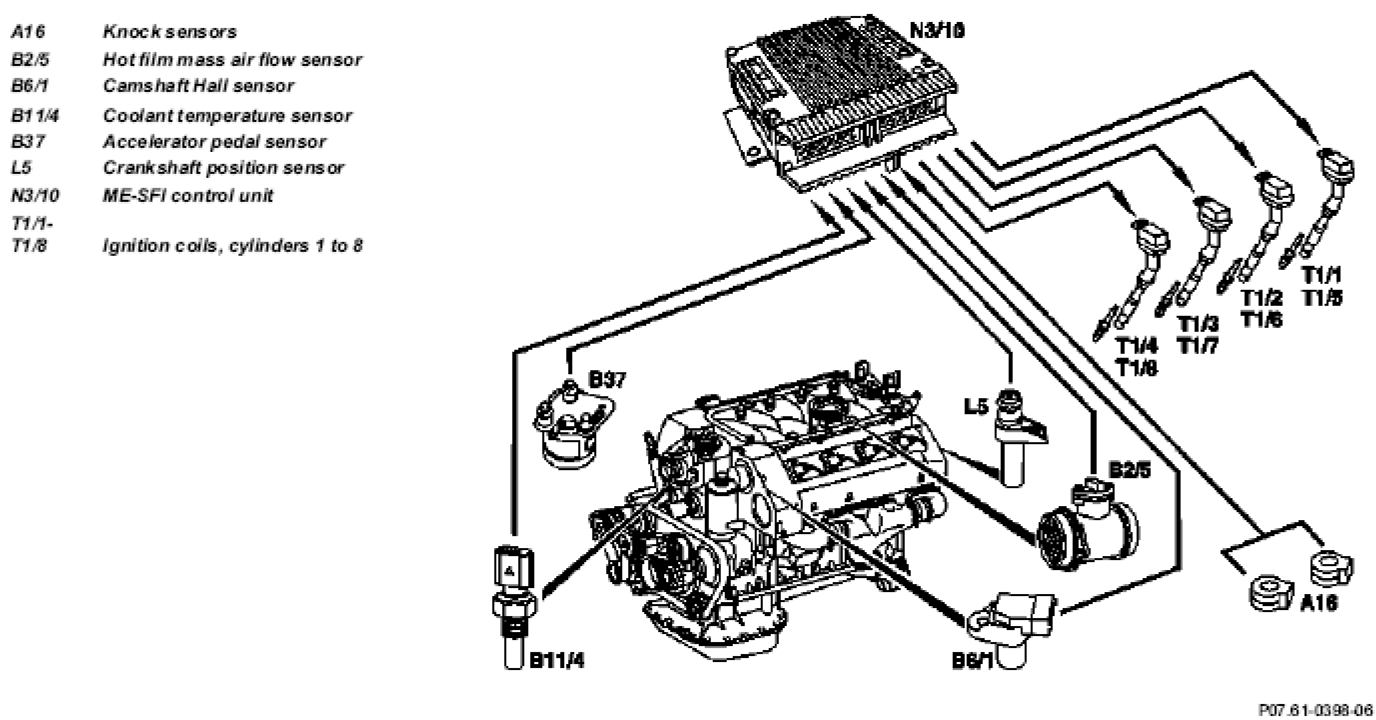


Fig. 15: Identifying Anti-Knock Control Components - Shown On Engine 119

Task

Ensuring knock-free operation of the engine with different fuels in all operating conditions from idling speed up to maximum speed of engine, from an engine load of more than approx. 40%. For this purpose, if uncontrolled combustion (knocking) occurs, the ignition angle at the relevant cylinder or cylinders is retarded.

Design/function

The anti-knock control (AKC) function is integrated in the ME-SFI control unit. The range of functions has been enlarged compared to previous versions.

Input signals:

- Engine speed (crankshaft position sensor)

- Camshaft position (camshaft Hall sensor)
- Knock identification:

  Engine 104, 111, 112, 113, 119, 120 by means of knock sensors Engine 137 by ionic current measurement

- Engine temperature (coolant temperature sensor)
- Engine load (hot film air flow sensor or pressure sensor on supercharged engines)
- Accelerator pedal position (accelerator pedal sensor)
- Precontrol by means of automatic RON switch (internal)

Output signals:

- Cylinder specific ignition angle correction on the calculated map value of the ME control unit.
- Ignition angle emergency mode if fault identified.

Basic function

The anti-knock control is active from a coolant temperature of 70 °C. If knocking is detected at a cylinder above an engine load of approx. 40%, its ignition angle is retarded from the next ignition by about 2.3° crank angle (e.g. M119) or by about 3.0° crank angle (e.g. M120). If knocking continues to be detected, the ignition angle is continuously retarded in steps of 2.3° crank angle (e.g. M119) until the maximum retardation is reached (approx. 10 to 15° crank angle, depending on engine speed). In addition, the automatic RON switch influences the maximum retarding of the ignition timing - the higher the selected RON stage, the less is the maximum retarding of the ignition timing.

If knocking-free combustion exists, the retardation is reduced in steps of approx. 0.75° crank angle after a few ignitions (depending on engine speed) until the map value (a) is achieved, or knocking once again occurs.

Adaptation of anti-knock control

The adaptation of the anti-knock control is active from a coolant temperature of approx. 75 °C. Any corrections required to the ignition angle because of knocking combustion are constantly detected for the specific cylinder and stored together with the relevant operating state of the engine (engine load/speed range).

The stored adaptation value is taken into account in the output of the individual cylinder angle so that each cylinder is immediately operated with the optimal ignition angle.

During abrupt acceleration, no values are stored for about 2 seconds in order to avoid any incorrect adaptation values.

Faults in the case of knocking detection

If no signals are received from the knock sensors or from the ionic current measurement, the ignition angle of all the cylinders is retarded, for safety reasons, by as much as approx. 11° crank angle depending on engine

speed and temperature. The anti-knock control and the adaptation are deactivated and a fault is stored.

Automatic RON switch

In addition to the RON correction using the HHT, the anti-knock control features an automatic RON switch. This detects a persistent high knocking tendency of the engine and assists the anti-knock control by means of an appropriate pre-control.

This is done by analyzing the stored adaptation values, the ignition angles of all the cylinders and the number of control interventions in certain engine load and speed ranges. Depending on the threshold which has been exceeded, the RON value is adjusted by one or several stages. The value is retained until the engine is switched off.

After engine start, only the RON correction which is carried out by means of the HHT/STAR DIAGNOSIS is at first active.

	Crankshaft position sensor, location/task/ design/function		**GF07.04-P-4116F**
	Camshaft Hall sensor, location/task/design/ function		**GF07.04-P-4117F**
	Knock sensors, location/task/design/function		**GF15.12-P-4101F**
	Coolant temperature sensor, location/task/ design/function	Engine 119, 120 Engine 104, 111 Engine 112, 113, 137	GF07.04-P-5026F GF07.04-P-5026G **GF07.04-P-5026A**
	Hot film mass air flow sensor, location/task/ design/function	Engine 119, 120 (round connector) Engine 104, 111, 112, 113, 137 Engine 111 EVO	GF07.07-P-4118E **GF07.07-P-4118G** GF07.07-P-4118GS
	Pedal value sensor, location/task/design/ function		**GF30.20-P-4011L**
	ME-SFI control unit position/task/design/ function	Engine 111 EVO	**GF07.61-P-5000F** GF07.61-P-5000GS
	ME-SFI synchronizing fuel injection and firing order function	Engine 111 EVO	**GF07.61-P-4009F** GF07.61-P-4009GS

KNOCK SENSORS, LOCATION - GF15.12-P-4101-01A

A16g1	KS 1 (right side of engine)
A16g2	KS 2 (left side of engine)

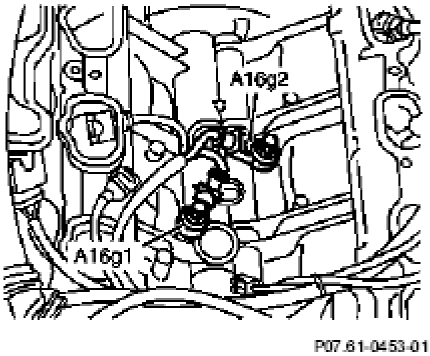


Fig. 16: Identifying Knock Sensors - Engine 112

KNOCK SENSORS, LOCATION - GF15.12-P-4101-01B

A16G1	KS 1 (right side of engine)
A16G2	KS 2 (left side of engine)

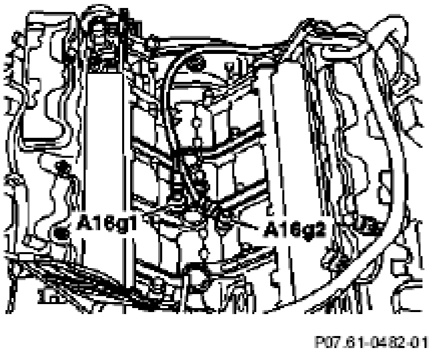


Fig. 17: Identifying Knock Sensors - Engine 113

KNOCK SENSORS, FUNCTION - GF15.12-P-4101-02KE

A16	Knock sensor
a	Signal pattern in the case of controlled combustion
b	Signal pattern in the case of uncontrolled combustion (knocking)
c	Oscilloscope
t	Time
U	Electrical voltage

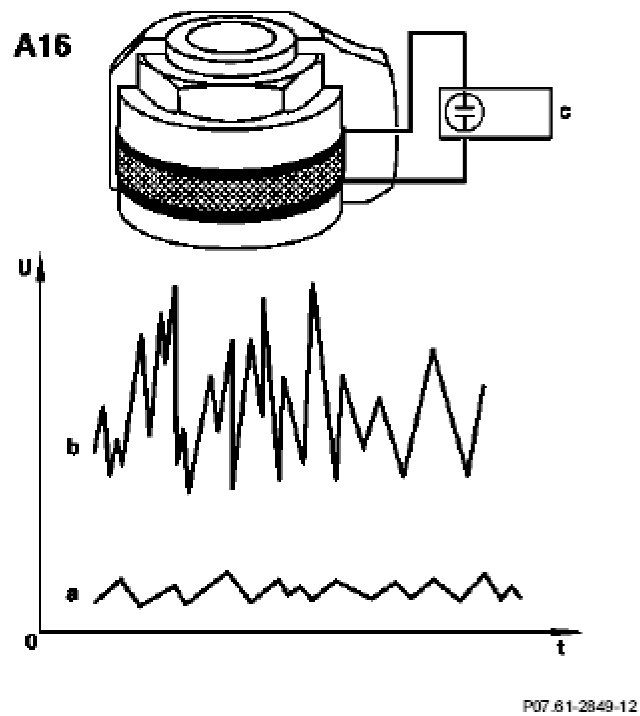


Fig. 18: Identifying Knock Sensors Oscilloscope Signals

Any vibrations which occur are converted with the aid of the piezo ceramic into electrical signals.

Piezo-electric effect: If a mechanical force acts on a crystal, electrical voltages are produced.

Knock sensor signals may also indicate engine damage, e.g. increased engine noise resulting from a widened piston groove.

KNOCK SENSORS, LOCATION/TASK/DESIGN/FUNCTION - GF15.12-P-4101F

ENGINE 104.941 /942 /943 /944 /945 /991 /992 /994 /995

ENGINE 111.921 /943 /944 /945 /946 /947 /960 /961 /970 /973 /974 /975 /977

ENGINE 111.942 as of 1.6.96

ENGINE 111.951 /952 /955 /956 /957 /958 /982 /983

ENGINE 119.980 /981 /982 /985

ENGINE 120.982/983

ENGINE

112.910 /911 /912 /913 /914 /916 /917 /920 /921 /922 /923 /940 /941 /942 /943 /944 /946 /947 /949 /953 /954 /9

ENGINE 113.940 /941 /942 /943 /948 /960 /961 /963 /965 /966 /967 /968 /969

ENGINE 166.940 /960 /990 /995



Fig. 19: Identifying Knock Sensors

	Knock sensors, location	Engine 104 Engine 111 Engine 112 Engine 113 Engine 119 Engine 120 Engine 166	GF15.12-P-4101-01D GF15.12-P-4101-01G **GF15.12-P-4101-01A** **GF15.12-P-4101-01B** GF15.12-P-4101-01E GF15.12-P-4101-01F GF15.12-P-4101-01GC
	Knock sensors, task	The knock sensor detects vibrations at the crankcase.	
	Knock sensors, design	The knock sensor is a self-contained system. Inside the sensor are piezo crystals. The screened cable is fitted directly onto the knock sensor.	
	Knock sensors, function		**GF15.12-P-4101-02KE**

STARTER CONTROL, FUNCTION - GF15.30-P-3000GA

ENGINE 111.921 /942 as of 1.9.98,

111.943 /944 /946 /947 /973 with CODE (423a) 5-speed automatic transmission (new-generation)

ENGINE 111.945

in MODEL 208.335 /435 as of 1.6.98,

202.020 /080 as of 1.9.98 with CODE (423a) 5-speed automatic transmission (new-generation)

ENGINE 111.974

with CODE (423a) 5-speed automatic transmission (new-generation)

with CODE (494a) USA version

with CODE (807) Model year 1997

with CODE (808) Model year 1998

ENGINE 111.975 as of 1.8.96 with CODE (423a) 5-speed automatic transmission (new-generation)

ENGINE
112.910 /911 /912 /913 /914 /916 /917 /920 /921 /922 /923 /940 /941 /942 /943 /944 /946 /947 /949 /953 /954 /9
with CODE (423a) 5-speed automatic transmission (new-generation)

ENGINE 113.940 /941 /942 /943 /948 /960 /961 /963 /965 /966 /967 /968 /969 with CODE (423a) 5-speed automatic transmission (new-generation)

ENGINE 120.983 as of 1.6.98

ENGINE 137.970

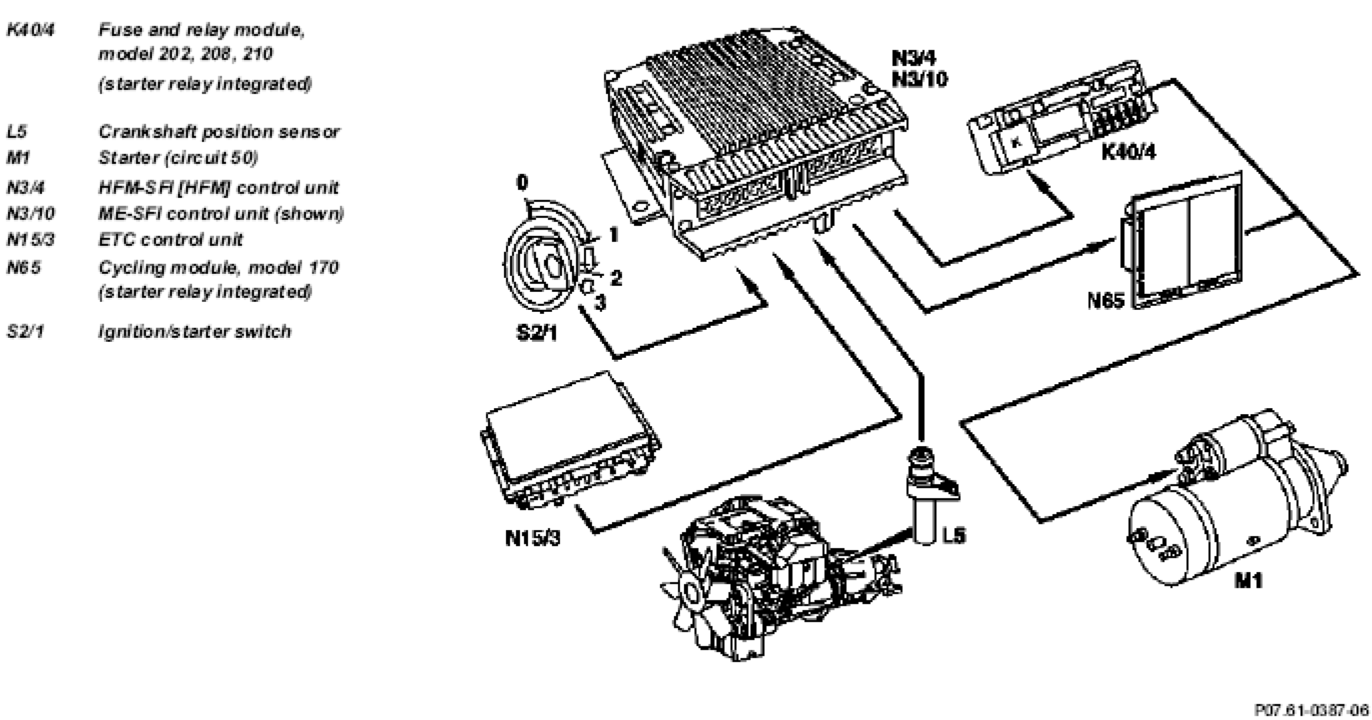


Fig. 20: Identifying Starter Function Components - Shown On Engine 111

Task

After engine start speed is reached, interrupt the circuit (circuit 50) M1 to the solenoid switch of the starter.

Design

The solenoid switch of the starter is operated not through the ignition/ start switch S2/1, but in drive position P or N through the starter relay, by the engine control unit.

The voltage for the starter relay (coil) is supplied through circuit 87. The starter relay is actuated by the engine control unit through GND.

Function

When the ignition/start switch is operated in the start position, the engine control unit activates an automatic start control. Once the engine start speed of 400 to 700 rpm is reached, the engine control unit interrupts the ground actuation to the starter relay and thus the engine start operation.

Once the engine start operation is initiated, shutting off circuit 50 at the ignition/start switch has no effect. The starter rotates until the specified start speed is reached, or for about 5 seconds at an engine temperature of +80 ° C, for a maximum of 10 seconds if the engine is cold.

	Motor electronics control unit, location/task/ design/function		**GF07.61-P-5000F**
	HFM-SFI control unit, location/task/design/ function		GF07.51-P-4103D
	Crankshaft position sensor, location/task/ design/function		**GF07.04-P-4116F**
	Start recognition function	Engine 104,, 111, 112, 113, 137 (via terminal 50)	**GF07.13-P-3014G**
		Engine 119, 120 (via engine speed signal)	GF07.13-P-3014F
	ETC control unit, location/task	Selector lever position information P/N and driving position engaged. Transmission 722.6	**GF27.19-P-4012G**
	Electronic ignition switch control unit, location/ task/design/function	Model 202 as of 6/97, 208, 210 as of 3/97	GF80.57-P-4102A
		Model 215, 220	GF80.57-P-4102S
		Model 203, 209	GF80.57-P-4102PP

SAFETY PRECAUTIONS

SAFETY INFORMATION: ELECTRICAL SYSTEM - ENGINE - AS15.00-Z-9999ZZ

MODEL all

	Risk of death caused by coming into contact with high-voltage parts although ignition is turned off.	ENGINE 137 ENGINE 275 ENGINE 285	AS15.15-Z-0001-01A
	Risk of death caused by contact with parts conducting high voltages.	ENGINE 103, 104, 111, 112, 113, 119, 120, 122, 132, 134, 135, 137, 155, 156, 160, 166, 266, 271, 272, 273, 275, 285, 613, 628, 629, 642, 646, 648, 902, 906...	**AS15.10-Z-0001-01A**

RISK OF DEATH CAUSED BY CONTACT WITH PARTS CONDUCTING HIGH VOLTAGES. - AS15.10-Z-0001-01A

Do not touch parts which conduct high voltages. Persons who wear electronic implants (e.g. heart pacemakers) must not carry out work on the ignition system

Risk of death caused by high voltages in the ignition system

Electronic ignition systems operate within a hazardous power range both on the low voltage side (primary circuit) as well as on the high voltage side (secondary circuit). Contacts with such parts can result in burns, heart flutter or cardiac arrest.



P15.11-0001-01

Fig. 21: High Voltage Warning

Safety instructions/precautions

- Persons with heart pacemakers must not perform any work on the ignition system.
- Switch ignition off before commencing any work on the ignition system.
- Do not touch or dismantle components of ignition system when working on running or rotating engine with cranking speed.
- Wear safety shoes (with rubber soles).
- Detach the crankshaft position sensor connection either at the control unit or at the position sensor.
- Do not install any electrically conducting, un-insulated adapters or installation sensors into the ignition cable.

TROUBLE DIAGNOSIS

STARTER OCCASIONALLY DOES NOT START - AF15.30-P-6405A

ENGINE 112 in MODEL 129, 163, 170, 202, 208, 210, 220

ENGINE 113 in MODEL 129, 163, 202, 208, 210, 215, 220

ENGINE 119 in MODEL 129, 210

ENGINE 120 in MODEL 129

Modification notes

24.7.00	Supersedes STIP 07.60-022 dated 28.2.00	Reference link updated.	

Damage code	Cause	Remedy	
15 001 41	Starting operation is terminated before engine can start. When starting tachometer jumps momentarily in direction > 2000 rpm.	DTC in ME-SFI control unit: No DTC stored. 1 Remove starter.	
		ENGINE 112, 113 in MODEL 129	AR15.30-P-7100CS
		ENGINE 119, 120 in MODEL 129	AR15.30-P-7100EC
		ENGINE 112, 113 in MODEL 210	AR15.30-P-7100FF
		ENGINE 119.985 129	AR15.30-P-7100FAF
		ENGINE 112 in MODEL 202 ENGINE 112.940 in MODEL 208	AR15.30-P-7100ED
		ENGINE 112.947 170	AR15.30-P-7100GA
		ENGINE 112.942, 113.942 in MODEL 163	**AR15.30-P-7100GH**
		ENGINE 113.960 in MODEL 215, ENGINE 112, 113 in MODEL 220	AR15.30-P-7100I
		2 Coat teeth on starter ring gear lightly with paste Use only paste specified in parts note Ensure that excessive	

		quantity of paste is not applied because this can interfere with the signal pickup of position sensor L5	
		3 Install starter.	

Parts ordering notes

Part no.	Designation	Quantity
000 989 76 51	Paste (1 kg)	1

TESTING & REPAIR

TESTING AND REPAIR WORK: PASSENGER CARS: ELECTRICAL SYSTEM - ENGINE - AR15.00-Z-9163AA

MODEL 163

	Servicing wiring harness	MODEL 124, 126, 129, 140, 163, 168, 170, 201, 202, 208, 210, 215, 220	**AR15.18-P-0500A**

REMOVE, INSTALL CAMSHAFT HALL SENSOR - AR15.10-P-2000A

ENGINE 112.945 in MODEL 463.209 /232 /233 /244 /245 /250

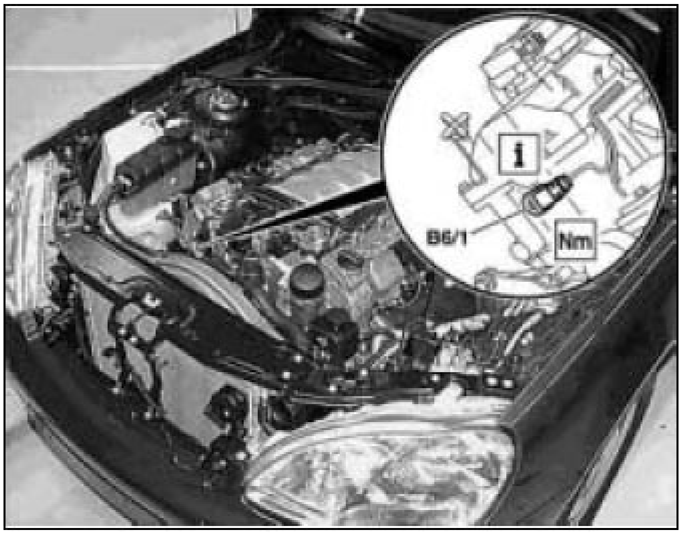
ENGINE 112 in MODEL 129, 163, 170, 202, 203, 208, 209.361 /365/461 /465, 210, 211.061 /261 /065 /265 /080 /082 /280 /282, 220, 230.467

ENGINE 113 (except 113.990/991) in MODEL 129, 163, 202, 208, 209.375/475/376/476, 210, 211.070 /270 /083 /283, 215, 220, 230.472 /474 /475

ENGINE 113.962 in MODEL 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113.982 in MODEL 463.243/246

B6/1 Camshaft Hall sensor



P15.10-0246-11

Fig. 22: Identifying Camshaft Hall Sensor - Shown On Engine 112 In Model 220

Fig. item etc.	Work instructions		
⚠ Danger!	Camshaft Hall sensor to cylinder head		***BA15.10-P-1002-03A**
B6/1	Camshaft Hall sensor	Replace O-ring.	

⚠ Danger! **Position sensor**

Number	Designation		Engines 112.910/911/ 912/913/914/ 915/916/917/ 920/921/922/ 923/940/941/ 942/943/944/ 945/946/947/ 949/951/953/ 954/955/960/ 961/970/972/ 973/975/976	Engines 113.940/941/ 942/943/944/ 948/960/961/ 962/963/964/ 965/966/967/ 968/969/971/ 980/981/982/ 984/986/992/ 993/995	Engine 113.987/ 988/990/ 991
BA15.10-P-1002-03A	Camshaft Hall sensor to cylinder head	Nm	8	8	8

TEST ROTORLESS HIGH VOLTAGE DISTRIBUTION - AR15.10-P-3000WA

ENGINE 112.923 /943, 113.961 in MODEL 129

ME-SFI fuel injection and ignition system with engine diagnostic tester Datascope D 980

ENGINE 112.942, 113.942/965/981 in MODEL 163

ME-SFI fuel injection and ignition system with engine diagnostic tester Datascope D 980

ENGINE 112.910 /920, 113.944 in MODEL 202

ME-SFI fuel injection and ignition system with engine diagnostic tester Datascope D 980

ENGINE 112.940, 113.943 in MODEL 208

ME-SFI fuel injection and ignition system with engine diagnostic tester Datascope D 980

ENGINE 112.911 /921 /941, 113.940/980 in MODEL 210

ME-SFI fuel injection and ignition system with engine diagnostic tester Datascope D 980

ENGINE 112.922 /944, 113.941 /960 in MODEL 220

ME-SFI fuel injection and ignition system with engine diagnostic tester Datascope D 980

AP	**Risk of accident.** Accidents may result if the vehicle starts off unintentionally with the engine running. **Risk of injury** as working around the engine during start-up or while running may result in contusions and burns	Secure vehicle to prevent it from moving. Wear closed and snug-fitting work clothes. Do not grasp hot or rotating parts.	**AS00.00-Z-0005-01A**
AP	**Risk of death.** Death may result if contact is made with parts carrying high voltages.	Do not touch parts carrying high voltages. Persons who wear electronic implants (e.g. heart pacemakers) must not carry out work on the ignition system.	**AS15.10-Z-0001-01A**
1	Remove air cleaner		
2	Remove trim panel of cylinder head cover		
3	Test ignition circuits	i Datascope engine diagnostic tester	***WH58.30-Z-1003-13A**
	General information on rotorless high voltage distribution		**AH15.10-P-1002-01WA**
	General information on testing rotorless high		**AH15.10-P-1003-01W**

	voltage distribution	if necessary: ? Test secondary side Secondary adapter cable in place of kV clamp. kV clamp in ignition coil recess alternately at ignition coil T1/1-T1/6 or T1/8 Test primary side Primary adapter cable alternatively at ignition coil T1/1-T1/6 or T1/8	

Commercially available tools

Number	Designation
WH58.30-Z-1003-13A	Engine tester

REMOVE/INSTALL IGNITION COILS - AR15.12-P-2003A

ENGINE 112.910 in MODELS 202.026 /086

ENGINE 112.920 in MODELS 202.029 /089

ENGINE 112.921 in MODELS 210.063 /081 /263 /281

ENGINE 112.922 in MODELS 220.063 /163

ENGINE 112.923 in MODEL 129.059

ENGINE 112.940 in MODELS 208.365 /465

ENGINE 112.941 in MODELS 210.065 /082 /265 /282

ENGINE 112.942 in MODEL 163.154

ENGINE 112.943 in MODEL 129.064

ENGINE 112.944 in MODELS 220.065 /165

ENGINE 112.945 in MODEL 463

ENGINE 113.940 in MODELS 210.070 /270

ENGINE 113.941 in MODELS 220.070 /170

ENGINE 113.960 in MODEL 215.375, 220.075 /175 /875

ENGINE 113.961 in MODEL 129.068

ENGINE 113.962 /982 in MODEL 463

ENGINE 113.980 in MODELS 210.074 /274

ENGINE 113.944 in MODELS 202.033 /093

ENGINE 113.942 in MODEL 163.172

ENGINE 113.943 in MODELS 208.370 /470

ENGINE 113.984 in MODELS 208.374

ENGINE 113.981 in MODEL 163.174

ENGINE 112.912 in MODELS 203.061 /261, 209.361 /461

ENGINE 112.946 in MODELS 203.064 /264

ENGINE 112.947 in MODEL 170.465

ENGINE 112.960 in MODEL 170.466

ENGINE 113.986 in MODEL 215.373, 220.073 /173

ENGINE 112.961 in MODELS 203.065 /265

ENGINE 113.965 in MODEL 163.175

ENGINE 113.963 in MODEL 230.475

ENGINE 113.968 in MODEL 209.375 /475

ENGINE 112.913 in MODELS 211.061 /261

ENGINE 112.949 in MODELS 211.065 /265

ENGINE 113.967 in MODELS 211.070 /270

ENGINE 113.992 in MODEL 230.474

ENGINE 113.987 in MODELS 209.376 /476

ENGINE 112.955 in MODELS 209.365 /465

ENGINE 113.990 in MODELS 211.076 /276

ENGINE 113.991 in MODELS 215.374, 220.074 /174

ENGINE 112.916 in MODELS 203.081 /281

ENGINE 112.953 in MODELS 203.084 /284

ENGINE 112.972 in MODELS 220.067 /167

ENGINE 112.973 in MODEL 230.467

ENGINE 112.970 in MODEL 163.157

ENGINE 112.975 in MODELS 220.087 /187

ENGINE 113.948 in MODELS 220.083 /183

ENGINE 113.966 in MODELS 220.084 /184

ENGINE 112.917 in MODELS 211.080 /280

ENGINE 112.954 in MODELS 211.082 /282

ENGINE 113.969 in MODELS 211.083 /283

ENGINE 113.988 in MODEL 203.076/276

ENGINE 113.993 in MODELS 463.270 /271

ENGINE 113.989 in MODEL 171.473

ENGINE 113.995 in MODEL 230.472

5/1	Spark plug connector
5/3	Bolt
T1/1	Cylinder 1 ignition coil
T1/2	Cylinder 2 ignition coil
T1/3	Cylinder 3 ignition coil
T1/4	Cylinder 4 ignition coil
T1/5	Cylinder 5 ignition coil
T1/6	Cylinder 6 ignition coil
T1/7	Cylinder 7 ignition coil
T1/8	Cylinder 8 ignition coil
Arrow:	Identification of the connector

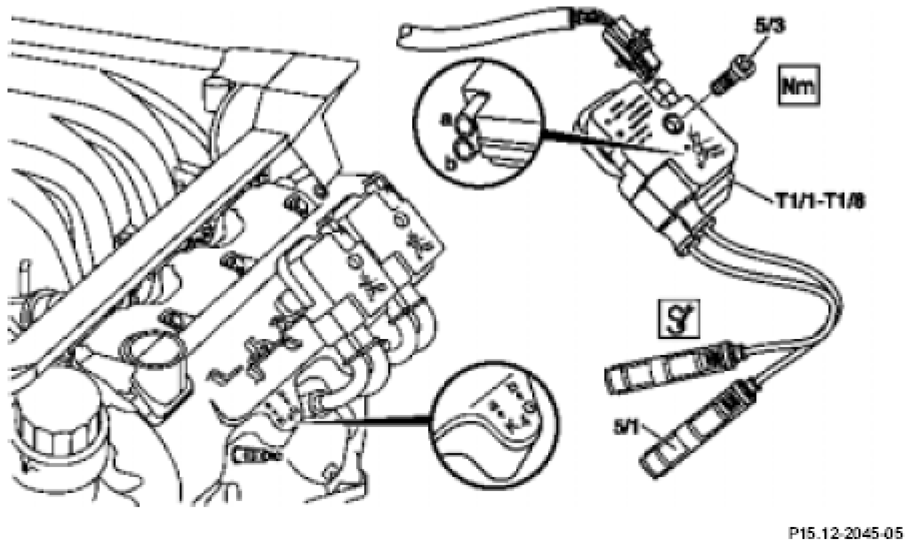


Fig. 23: Identifying Ignition Coil Remove/Install Components - Shown On Engine 112

Modification notes

16.5.06	"Disconnect/connect ground line on battery" removed	Model 203, 209,	

	Remove/install		
AP	Risk of death caused by touching parts which conduct high voltages	Do not touch parts which conduct high voltages. Persons who wear electronic implants (e.g. heart pacemakers) should never perform any work on the ignition system.	**AS15.10-Z-0001-01A**
Danger!	Notes on avoiding damage to ignition system		**AH15.10-P-0002-01D**
1.1	Deactivate service mode in TELE AID emergency call system	Only on model 463.270 with code: Tele-Aid car phone emergency call system ET2.	AR82.95-P-0005-03GR
	Notes on TELE AID emergency call system	Model 463.243/244/245/247/248/250/ 254/270/309/322/323/332/333 TELE AID car telephone emergency call system ET2	AH82.95-P-0001-01GA
2	Disconnect ground line from battery	Model 463 except model 463.241/248 with code 979 special protection version	AR54.10-P-0003G
		Model 463.241 with: special protection version code 979, -special protection version FB4 with code ZS4, -special protection	AR54.10-P-0003PV

		version FB6 with code ZS6, -special protection version FB7 with code ZS7, additional battery 100 Ah incl. cutoff relay code E26.	
		Model 463.248 with: special protection version, code 979, -special protection version FB6, code ZS6, -special protection version FB7, code ZS7, -additional battery 100 Ah including cutoff relay, code E26.	AR54.10-P-0003PM
3.1	Unclip cover on front side of engine	Model 211, 215, 220, 230.475/476	
4.1	Remove engine cover with integrated air filter	Except model 170.466, 203.065/076/265/276, 209.376/476 from 24.4.04, 211.076/276, 215.374, 220.074/174, 230.474, 463.270/271 The air filter is integrated in the engine cover. Remove the engine cover or the air filter housing by pulling it from the cylinder head covers vertically in the upward direction.	
4.2	Remove air filter housing	Model 170.466, 203.065/265, 211.076/276, 215.374, 220.074/174, 230.474	AR09.10-P-1150SVK
		Model 203.076 /276, 209.376 /476 from 24.4.04, 171.473	AR09.10-P-1150AC
		Model 463.270/271	AR09.10-P-1150GX
5	Unscrew screw (5/3)	Danger!	***BA15.10-P-1001-04A**
6	Detach spark plug connector (5/1) from the spark plugs	Pry off spark plug connector (5/1) using open-end wrench, double over the cylinder head cover of the spark plugs. Installation: Observe the identification of the connector (arrow) on the cylinder head cover and the ignition coil of cylinders 1 to 6 or 1 to 8 for the corresponding spark plug connector (5/1).	
		Double open-ended wrench	**Fig. 24**
7	Separate electrical connector of ignition coil of cylinder 1 to 6 (T1/1	**Installation:** Install new cable ties.	

	to T1/6) or 1 to 8 (T1/1 to T1/8)		
8	Remove ignition coil of cylinder 1 to 6 (T1/1 to T1/6)or 1 to 8(T1/1 to T1/8)		
9	Install in the reverse order		
10.1	Activate Service mode in Tele-Aid emergency call system	Only on model 463.270 with code: Tele-Aid car phone emergency call system ET2.	AR82.95-P-0005-03GR
	Notes on TELE AID emergency call system	Model 463.243/244/245/247/248/250/254/270/309/322/323/332/333 TELE AID car telephone emergency call system ET2	AH82.95-P-0001-01GA

Danger! **Ignition coil**

Number	**Designation**		**Engines 112,113**
BA15.10-P-1001-04A	Bolt for ignition coil on cylinder head cover	Nm	8

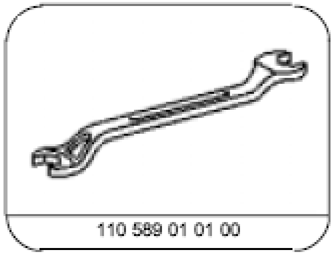


Fig. 24: Identifying Double Open-End Wrench (110 589 01 01 00)

REMOVE/INSTALL CRANKSHAFT POSITION SENSOR - AR15.12-P-2133A

ENGINE 112.910 in MODEL 202.026 /086

ENGINE 112.920 in MODEL 202.029 /089

ENGINE 112.921 in MODEL 210.063 /081 /263 /281

ENGINE 112.922 in MODEL 220.063

ENGINE 112.923 in MODEL 129.059

ENGINE 112.940 in MODEL 208.365 /465

ENGINE 112.941 in MODEL 210.065/082/265/282

ENGINE 112.942 in MODEL 163.154

ENGINE 112.943 in MODEL 129.064

ENGINE 112.944 in MODEL 220.065/165

ENGINE 113.940 in MODEL 210.070 /270

ENGINE 113.941 in MODEL 220.070/170

ENGINE 113.960 in MODEL 215.375,220.075/175

ENGINE 113.961 in MODEL 129.068

ENGINE 112.945 in MODEL 463.209 /232 /233 /244 /245 /250

ENGINE 113.944 in MODEL 202.033 /093

ENGINE 113.980 in MODEL 210.074/274

ENGINE 113.943 in MODEL 208.370 /470

ENGINE 113.984 in MODEL 208.374

ENGINE 113.981 in MODEL 163.174

ENGINE 112.912 in MODEL 203.061/261,209.361 /461

ENGINE 112.946 in MODEL 203.064 /264

ENGINE 112.947 in MODEL 170.465

ENGINE 112.960 in MODEL 170.466

ENGINE 113.942 in MODEL 163.172

ENGINE 112.961 in MODEL 203.065 /265

ENGINE 113.965 in MODEL 163.175

ENGINE 113.963 in MODEL 230.475

ENGINE 112.913 in MODEL 211.061 /261

ENGINE 112.949 in MODEL 211.065/265

ENGINE 113.967 in MODEL 211.070/270

ENGINE 113.962 in MODEL 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113.982 in MODEL 463.243 /246

ENGINE 112.955 in MODEL 209.365 /465

ENGINE 112.916 in MODEL 203.081 /281

ENGINE 112.953 in MODEL 203.084 /284

ENGINE 112.973 in MODEL 230.467

ENGINE 112.972 in MODEL 220.067/167

ENGINE 112.970 in MODEL 163.157

ENGINE 112.975 in MODEL 220.087/187

ENGINE 113.948 in MODEL 220.083/183

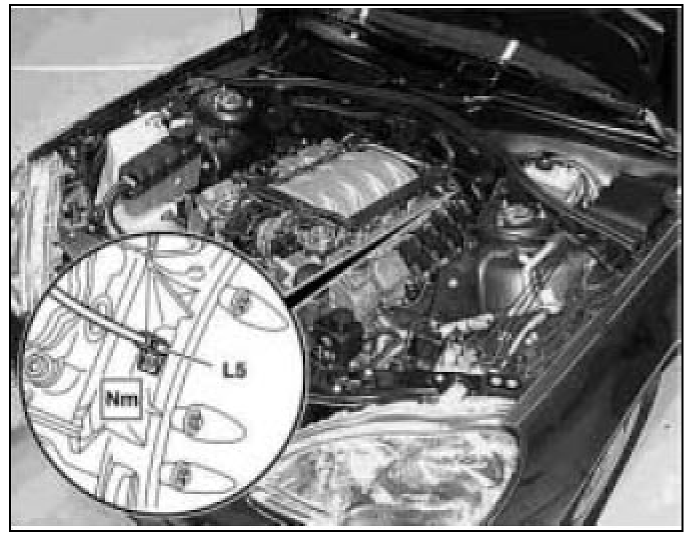
ENGINE 113.966 in MODEL 220.084/184

ENGINE 112.917 in MODEL 211.080/280

ENGINE 112.954 in MODEL 211.082/282

ENGINE 113.969 in MODEL 211.083/283

L5 Crankshaft position sensor



P15.12-0275-11

Fig. 25: Identifying Crankshaft Position Sensor - Shown On Engine 113 In Model 220

	Remove/install		
1.1	Remove engine cover with integrated air filter	All except Engine 112.960 in Model 170.466, Engine 112.961 in Model 203.065 /265 Remove air filter housing by lifting vertically up and off the cylinder head covers. **Installation:** Slightly moisten rubber retainers on cylinder head covers and sealing ring of hot film mass air flow sensor in the air filter housing with lubricating paste Lubricating paste	***BR00.45-Z-1002-06A**
1.2	Remove air filter housing	Engine 112.960 in model 170.466 Engine 112.961 in model 203.065/ 265	AR09.10-P-1150SVK
2	Remove crankshaft position sensor (L5)	⚠ Danger!	***BA15.10-P-1001-03A**
3	Install in the reverse order		
4	Re-initialize crankshaft position sensor (L5) using STAR DIAGNOSIS	If crankshaft position sensor (L5)was replaced, a re-initialization must be	

		carried out with STAR-DIAGNOSIS in the menu item control unit adaptations.	

⚠ Danger! **Position sensor**

Number	Designation		Engine 112.910/911/ 912/913/914/ 915/916/917/ 920/921/922/ 923/940/941/ 942/943/944/ 945/946/947/ 949/951/953/ 954/955/960/ 961/970/972/ 973/975/976	Engine 113.940/941/ 942/943/944/ 948/960/961/ 962/963/964/ 965/966/967/ 968/969/971/ 980/981/982/ 984/986/992/ 993/995
BA15.10-P-1001-03A	Crankshaft position sensor to engine block	Nm	8	8

Repair materials

Number	Designation	Order number
BR00.45-Z-1002-06A	lubricating paste	A 000 989 01 60

REMOVE/INSTALL KNOCK SENSORS - AR15.12-P-2184A

ENGINE 112.910 in MODEL 202.026 /086

ENGINE 112.920 in MODEL 202.029 /089

ENGINE 112.921 in MODEL 210.063 /081 /263 /281

ENGINE 112.922 in MODEL 220.063 /163

ENGINE 112.923 in MODEL 129.059

ENGINE 112.940 in MODEL 208.365 /465

ENGINE 112.941 in MODEL 210.065/082/265/282

ENGINE 112.942 in MODEL 163.154

ENGINE 112.943 in MODEL 129.064

ENGINE 112.944 in MODEL 220.065/165

ENGINE 113.940 in MODEL 210.070 /270

ENGINE 113.941 in MODEL 220.070 /170

ENGINE 113.960 in MODEL 215.375, 220.075/175

ENGINE 113.961 in MODEL 129.068

ENGINE 112.945 in MODEL 463.209 /232 /233 /244 /245 /250

ENGINE 113.944 in MODEL 202.033 /093

ENGINE 113.980 in MODEL 210.074/274

ENGINE 113.943 in MODEL 208.370 /470

ENGINE 113.984 in MODEL 208.374

ENGINE 113.981 in MODEL 163.174

ENGINE 112.912 in MODEL 203.061 /261, 209.361 /461

ENGINE 112.946 in MODEL 203.064 /264

ENGINE 112.947 in MODEL 170.465

ENGINE 112.960 in MODEL 170.466

ENGINE 113.942 in MODEL 163.172

ENGINE 112.961 in MODEL 203.065 /265

ENGINE 113.965 in MODEL 163.175

ENGINE 113.963 in MODEL 230.475

ENGINE 113.968 in MODEL 209.375 /475

ENGINE 112.913 in MODEL 211.061 /261

ENGINE 112.949 in MODEL 211.065/265

ENGINE 113.967 in MODEL 211.070 /270

ENGINE 113.987 in MODEL 209.376 /476

ENGINE 112.955 in MODEL 209.365 /465

ENGINE 113.962 in MODEL 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113.982 in MODEL 463.243 /246

ENGINE 112.953 in MODEL 203.084 /284

ENGINE 112.916 in MODEL 203.081 /281

ENGINE 112.973 in MODEL 230.467

ENGINE 112.972 in MODEL 220.067 /167

ENGINE 112.970 in MODEL 163.157

ENGINE 112.975 in MODEL 220.087 /187

ENGINE 113.948 in MODEL 220.083 /183

ENGINE 113.966 in MODEL 220.084/184

ENGINE 112.917 in MODEL 211.080 /280

ENGINE 112.954 in MODEL 211.082 /282

ENGINE 113.969 in MODEL 211.083 /283

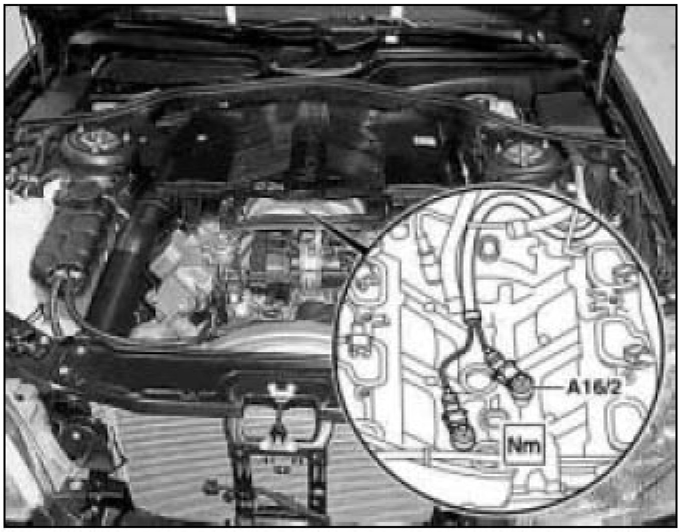
ENGINE 113.990 in MODEL 211.076 /276

ENGINE 113.988 in MODEL 203.076 /276

ENGINE 113.993 in MODEL 463.270 /271

ENGINE 113.989 in MODEL 171.473

A16/2 Left knock sensor 2



P15.12-0276-11

Fig. 26: Identifying Left Knock Sensor 2 - Shown On Engine 112 In Model 220

i ✕	**Remove/install**		
1.1	Remove intake manifold	All except model, 463 with engine 113.962/982/993 Model 463 with engine 112.945 Model 170.466 with engine 112.960 Model 203.065/265 with engine 112.961 Model 211.076/276 with engine 113.990	**AR09.20-P-1310A**
		Model 463 with Engine 112.945, 113.962/982	AR09.20-P-1310AG
1.2	Remove compressor	Model 170.466 with engine, 112.960 model 203.065/265 with engine, 112.961 model 211.076/276 with engine 113.990	AR09.50-P-4705SVK
		Model 463.270/271 with engine 113.993	AR09.50-P-4705GX
2	Detach knock sensor 1, right and knock sensor 2, left (A16/2) from cylinder block	⚠ Danger!	***BA15.10-P-1001-02A**
3	Install in the reverse order		

⚠ Danger! **Knock sensors**

Number	Designation		Engine 112.910/911/ 912/913/914/ 915/916/917/ 920/921/922/ 923/940/941/ 942/943/944/ 945/946/947/ 949/951/953/ 954/955/960/ 961/970/972/ 973/975/976	Engine 113.940/941/ 942/943/944/ 945/946/948/ 960/961/962/ 963/964/965/ 966/967/968/ 969/971/980/ 981/982/984/ 986/987/988/ 990/991/992/ 993/995	Engine 113.989
BA15.10-P-1001-02A	Bolt securing knock sensor to cylinder block	Nm	20	20	20

SERVICING WIRING HARNESS - AR15.18-P-0500A

MODEL 124, 126, 129, 140, 163, 168, 170, 201, 202, 208, 210, 215, 220

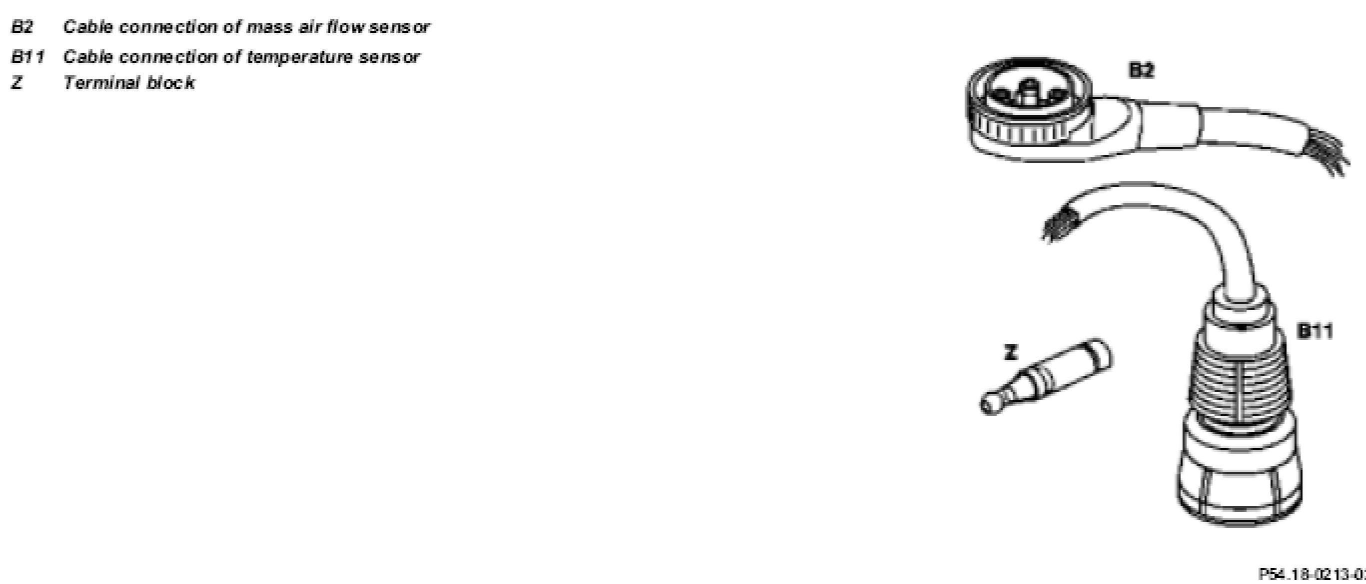


Fig. 27: Identifying Terminal Block And Cable Connection Of Mass Air Flow Sensor And Temperature Sensor

If a cable break or similar damage exists in the area of the plug connection of the mass air flow sensor (B2) or temperature sensor (B11), it is possible to repair the wiring harness in order to avoid costly replacement of a wiring harness.

Modification notes

27.9.99	Supersedes SI 54/76 dated 23.1.96	Remove SI 54/76 from your file.	

	Removing and installing		
1	Remove air cleaner, install.	Only on engine 119	
2	Expose wiring harness to mass air flow sensor or temperature sensor.	Danger! **Ignition switched off**	
3	Unplug socket from mass air flow sensor or temperature sensor.		
4	Plug in repair socket together with cables at mass air flow sensor or temperature sensor and insert into cable duct.		
5	Repair wiring harness using end soldering sleeves (Z).	Turn together cable of engine wiring harness and cable repair socket of the same color and insert into end soldered sleeves (Z). Use end soldered sleeves (Z) only in cross section area Ø 0.7 - Ø 4.0 mm^2	**AR54.18-P-0100-02A**
6	Insert cables into the cable duct.		
7	Connect HHT, read faults and erase	see Diagnosis Manual Engine Volume 2 Index 0: Connecting and using test equipment	
8	Install in the reverse order		

Parts ordering notes

Part no.	**Designation**	**Quantity**
140 540 00 36	Repair kit socket (B2)1 1) Consisting of repair socket (B2) and 5 cable connectors	acc. to condition
140 540 00 81	Repair socket (B2)	acc. to condition
202 540 01 81	Repair socket (B11) 3-pin	acc. to condition
126 540 30 81	Repair socket (B11) 4-pin	acc. to condition
001 546 99 41	Cable connector	acc. to condition
006 989 84 85	Fabric tape	acc. to condition

REMOVE AND INSTALLING THE STARTER - AR15.30-P-7100GH

ENGINE 112.942 in MODEL 163.154

ENGINE 112.970 in MODEL 163.157

ENGINE 113.942 in MODEL 163.172

ENGINE 113.981 in MODEL 163.174

ENGINE 113.965 in MODEL 163.175

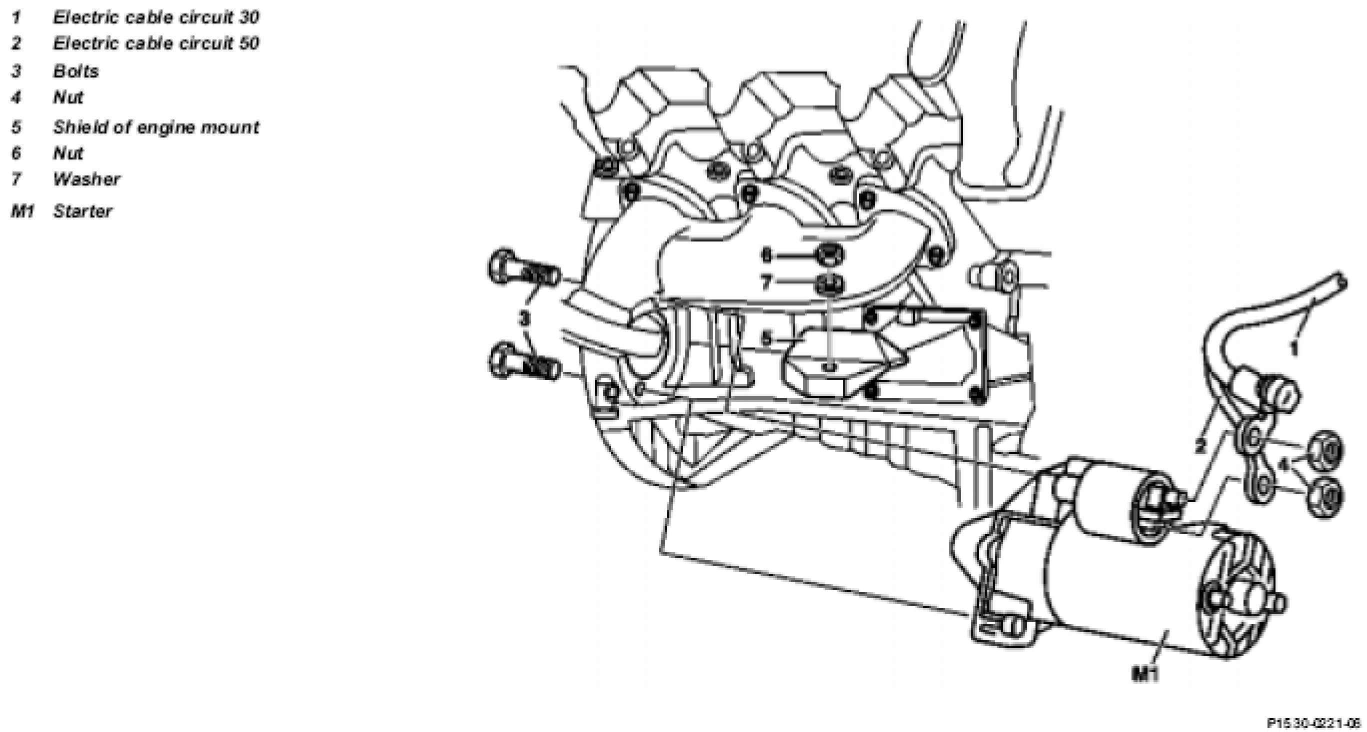


Fig. 28: Identifying Starter Remove/Install Components

Modification notes

3.9.03	Check ring gear, newly recorded	Stage 7	

i ⌧	**Removing/installing**		
⌧	**Risk of explosion** caused by oxyhydrogen gas. **Risk of poisoning and caustic burns** caused by swallowing battery acid. Risk of injury through burns to skin and eyes from battery acid or when handling damaged lead-acid batteries	No fire, sparks, open flames or smoking. Wear acid-resistant gloves, clothing and safety glasses. Only pour battery acid into suitable and appropriately marked containers.	**AS54.10-Z-0001-01A**
⚠ Danger!	Notes on self-locking nuts and bolts		**AH00.00-N-0001-01A**

1 ⚠ Danger!	Disconnect ground cable from battery Notes on battery	Insulate ground line as a protection against unintentional contact of dismounted ground line with ground point of battery.	**AR54.10-P-0003A** **AH54.10-P-0001-01A**
2	Remove inner fender in right front fender		**AR88.10-P-1300GH**
3.1	Unscrew nut (6) at shield (5) of left engine mount and take out shield	Engine 112 ⚠ Danger!	***BA22.10-P-1004-01L**
4	Dismount electrical line circuit 30 (1) and electrical line circuit 50 (2)	⚠ Danger! Nut, terminal 30 connection ⚠ Danger! Nut of connection circuit 50	***BA15.30-P-1001-01A** ***BA15.30-P-1002-01A**
5	Remove bolts (3)	⚠ Danger!	***BA15.30-P-1003-01A**
6	Take out starter (M1) to the side		
7.1	Check ring gear at flywheel for wear and damage	When replacing the starter on vehicles fitted with manual transmission Rotate engine at the crankshaft in direction of rotation.	
7.2	Check ring gear on the drive plate for wear and damage	When replacing the starter on vehicles fitted with automatic transmission Rotate engine at the crankshaft in direction of rotation.	
8	Install in reverse order		
9	Perform function check		
10	Render electrical system operational	See ? Perform basic programming	**AR00.19-P-0200GH**
11 ☞ WF	Read out fault memory and erase	When the work is complete stored faults must be worked on in the diagnostic trouble code memories and erased. ? Connect up STAR DIAGNOSIS, read out fault memory	 **AD00.00-P-2000-04A**

⚠ Danger! **Starter**

Number	Designation		Engine 112 except 112.951, 113.94/ 96/98
BA15.30-P-1001-01A	Nut for connection of circuit 30	Nm	14
BA15.30-P-1002-01A	Nut for connection of circuit 50	Nm	6
BA15.30-P-1003-01A	Bolt for starter on crankcase	Nm	42

⚠ Danger! **Engine mounts, engine supports**

Number	Designation		Engines 112.942/970 113.942/965/981 in model 163.154/157/17 2/174/175
BA22.10-P-1004-01L	Bolt for front engine mount on engine support	Nm	65

PREREQUISITES FOR TESTING GENERATOR - AR15.40-P-5009GH

ENGINE 111.977, 112.942/970, 113.942/965/981, 612.963, 628.963 in MODEL 163

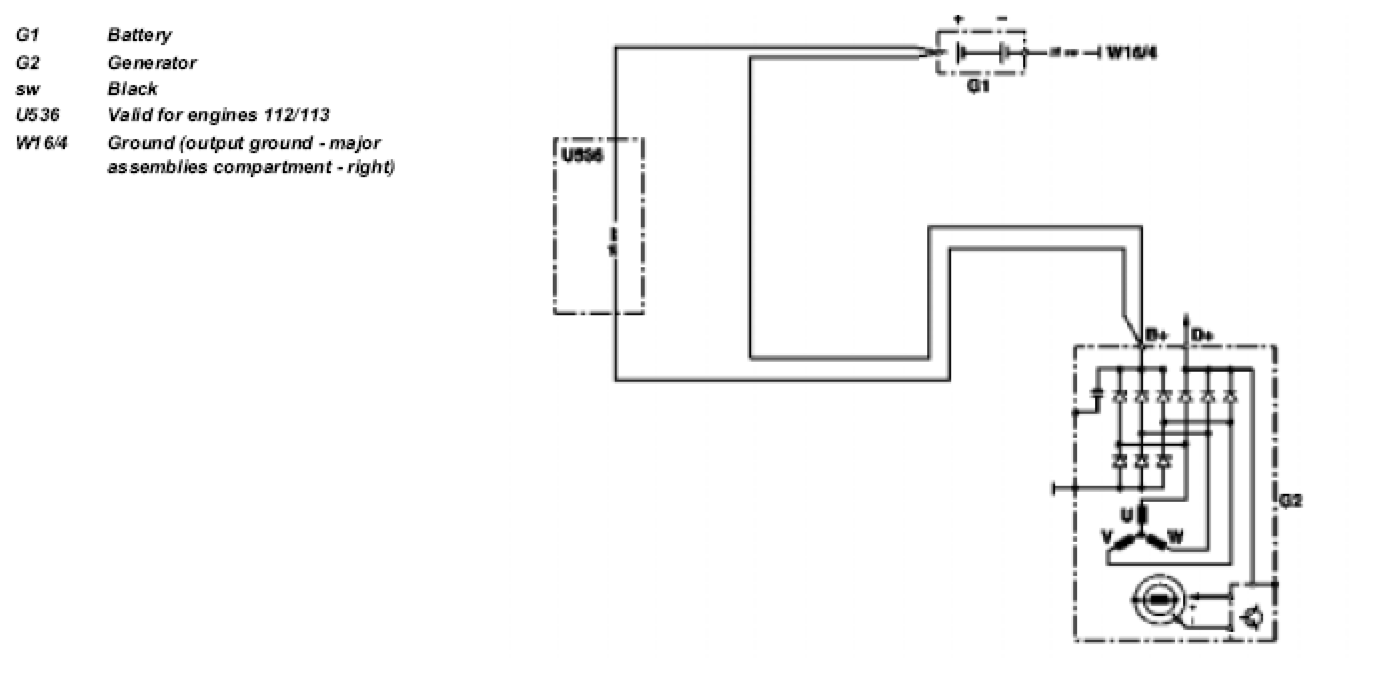


Fig. 29: Connection Schematic Between Battery And Alternator

[i] [X]	Remove/Install		
1	Open engine hood and raise	Up to A145272, X708318.	**AR88.40-P-1000GH**

	to vertical position	As of A145273, X708319.	**AR88.40-P-1000GI**
	Testing		
2	Check electrical line terminal 30 to the following items for firm seat and flawless condition	• Battery (G1) (+) • Generator (G2)(B+)	
3	Check electric cable for circuit 31 at the following positions for correct seat and condition	• Battery (G1) (-) • Right major assemblies compartment ground, Common ground (W16/4) • Engine ground strap/body	
4	Inspect tension of poly V-belt		
5	Inspect operation of charge indicator in instrument cluster		***BE54.30-P-1001-01A**
6	Install in the reverse order		

Test values for generator charge indicator lamp

Number	Designation		Model 129, 163, 168, 170, 202, 203, 208, 210
BE54.30-P-1001-01A	Position of ignition / glow start switch	Charge indicator lamp Off	0/1
		Charge indicator lamp On	2

CHECKING REGULATION VOLTAGE OF ALTERNATOR - AR15.40-P-5010GH

ENGINES 111.977, 112.942/970, 113.942/965/981, 612.963, 628.963 in MODEL 163

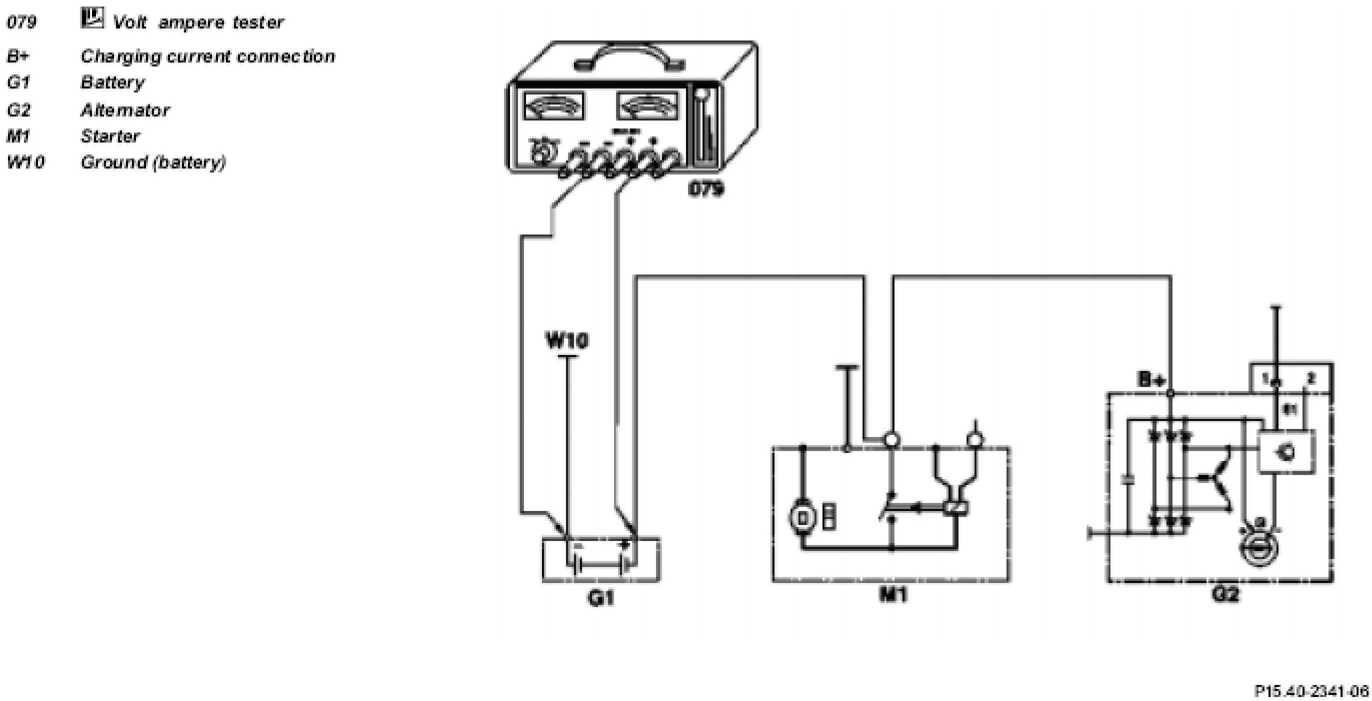


Fig. 30: Identifying Connection Diagram - Checking For Alternator Regulation Voltage

	Checking		
	Risk of explosion caused by oxyhydrogen gas. **Risk of poisoning and caustic burns** caused by swallowing battery acid. **Risk of injury** caused by burns to skin and eyes from battery acid or when handling damaged lead-acid batteries	No fire, sparks, open flames or smoking. Wear acid-resistant gloves, clothing and safety glasses. Only pour battery acid into suitable and appropriately marked containers.	**AS54.10-Z-0001-01A**
Danger!	Notes on battery		**AH54.10-P-0001-01A**
1	Check condition of battery (G1)		**AR54.10-P-1129Z**
2	Check whether preconditions for alternator testing have been fulfilled		**AR15.40-P-5009GH**
3	Attach volt ampere tester (079) according to connection plan	i Volt ampere tester with load resistance i Volt ampere tester ETT 011.00	***WH58.30-Z-1002-09A** ***WH58.30-Z-1003-09A**
	Risk of accident caused	Secure vehicle to prevent it	**AS00.00-Z-0005-01A**

	by vehicle starting off by itself when engine is running. **Risk of injury** caused by contusions and burns during starting procedure or when working near the running engine	from moving by itself. Wear closed and snug-fitting work clothes. Do not grasp hot or rotating parts.	
4	Start engine		
5	Check function of charge indicator lamp when engine is idling and with increasing engine speed (up to 3000 rpm)	Charge indicator lamp must extinguish.	
6	Load battery (G1) using a permanent consumer and check regulation voltage of alternator (G2)	Engines 111, 112, 113	***BE15.40-P-1001-02A**
		Engines 612, 628	***BE15.40-P-1001-02C**
		Volt ampere tester with load resistance	***WH58.30-Z-1002-09A**
		Volt ampere tester ETT 011.00	***WH58.30-Z-1003-09A**
		Regulation voltage > 15.0 V: ? • Replace regulator Engine 628	
		Engines 111, 112, 113 • Replace alternator (G2)	**AR15.40-P-5760GH**
		Engine 612	AR15.40-P-5032GI
		Regulation voltage < 13.0 V: ? • Check electrical connections for charging system for transition resistances; repair if necessary. Electrical connections OK: ?	
		• Check alternator (G2) diodes	**AR15.40-P-9301-02EA**

		Engine tester with oscilloscope If diodes are faulty: ? • Replace alternator (G2) Engine 111, 112, 113 Engine 612 Engine 628	***WH58.30-Z-1046-13A** **AR15.40-P-5032GH** AR15.40-P-5032GI AR15.40-P-5032IA
7	Turn off engine		
8	Disconnect volt ampere tester (079)	i Volt ampere tester with load resistance i Volt ampere tester ETT 011.00	***WH58.30-Z-1002-09A** ***WH58.30-Z-1003-09A**

Check values for regulator

Number	Designation			Engines 103,104,111, 112,113,119, 120, 137, 155, 166, 275
BE15.40-P-1001-02A	Regulating voltage (at battery)	Loading: only on permanent consumer	V	13 to 15
		Engine speed	rpm	3000
		measured after	min	approx.2

Check values for regulator

Number	Designation			Engines 601,602,603, 604, 605, 606, 611,613,628, 646, 647, 668	Engine 612 except 612.966
BE15.40-P-1001-02C	Regulating voltage (at battery)	Loading: only on permanent consumer	V	13 to 15	13 to 15
		Engine speed	rpm	3000	3000
		measured after	min	approx.2	approx.2

Commercially available tools

Number	Designation
WH58.30-Z-1002-09A	Volt-amp(s) tester with load resistance (no longer available)
WH58.30-Z-1003-09A	Volt ampere tester
WH58.30-Z-1046-13A	Engine tester with oscilloscope

CHECKING CHARGING CURRENT OF ALTERNATOR - AR15.40-P-5011GH

ENGINES 111.977, 112.942/970, 113.942/965/981, 612.963, 628.963 in MODEL 163

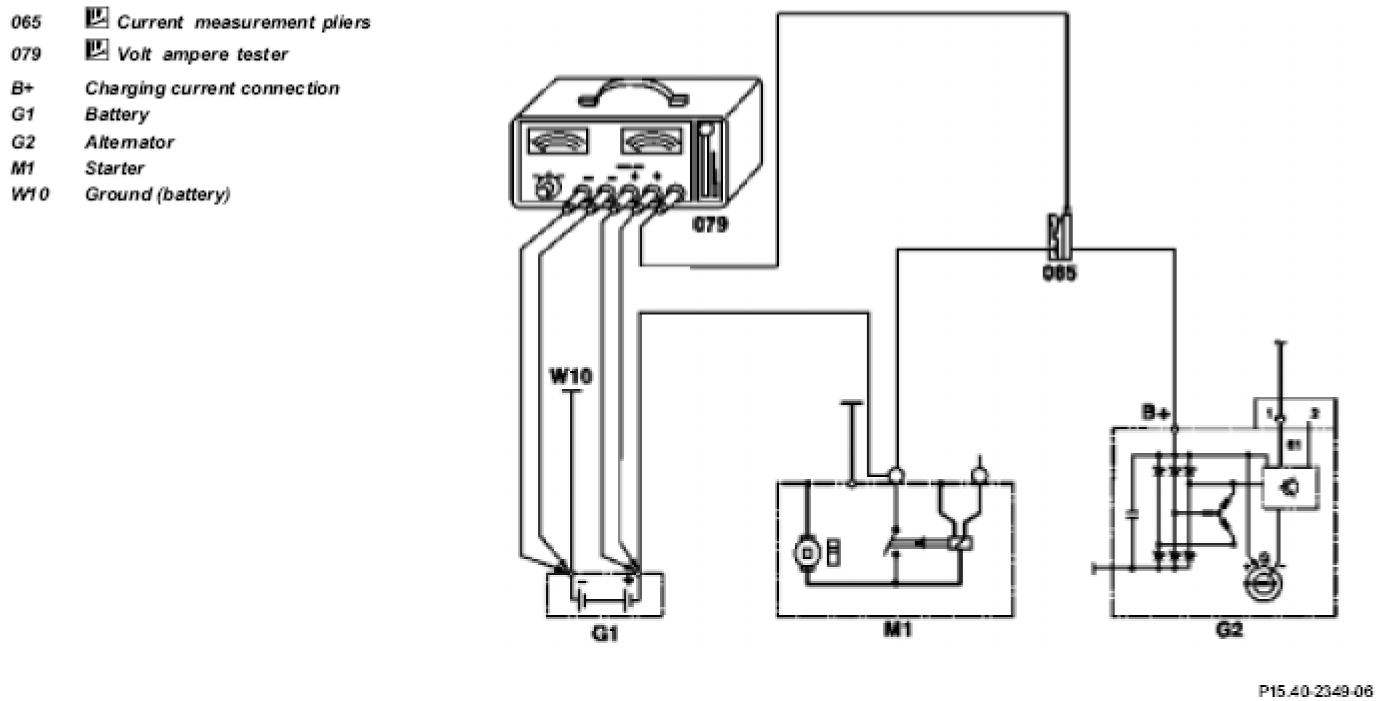


Fig. 31: Identifying Checking For Alternator Charging Current

Modification notes

18.10.05	Charging current of alternator	Engine 111	***BE15.40-P-1001-01A**

	Checking		
	Risk of explosion caused by oxyhydrogen gas. **Risk of poisoning and caustic burns** caused by swallowing battery acid. Risk of injury caused by burns to skin and eyes from battery acid or when handling damaged lead-acid batteries	No fire, sparks, open flames or smoking. Wear acid-resistant gloves, clothing and goggles. Only pour battery acid into suitable and appropriately marked containers.	**AS54.10-Z-0001-01A**
Danger!	Notes on battery		**AH54.10-P-0001-01A**
1	Check regulation voltage of alternator		**AR15.40-P-5010GH**
2	Connect volt ampere tester (079) with current clamp (065) according to	i Volt ampere tester with load resistance i Volt ampere tester ETT	***WH58.30-Z-1002-09A** ***WH58.30-Z-1003-09A**

	connection diagram	011.00	
⊠	**Risk of accident** caused by vehicle starting off by itself when engine is running. **Risk of injury** caused by contusions and burns during starting procedure or when working near the running engine	Secure vehicle to prevent it from moving by itself. Wear closed and snug-fitting work clothes. Do not grasp hot or rotating parts.	**AS00.00-Z-0005-01A**
3	Start engine		
4	Load battery (G1) with volt ampere tester (079) and check charging current of alternator (G2) with increased engine speed	Vary load resistance long enough until the maximum load current is achieved; when this is done, the regulating voltage must not drop below 12.7 V.	
		Engines 111, 612	***BE15.40-P-1001-01A**
		Engines 112, 113	***BE15.40-P-1001-01K**
		Engine 628	***BE15.40-P-1001-01J**
		[i] Volt ampere tester with load resistance	***WH58.30-Z-1002-09A**
		[i] Volt ampere tester ETT 011.00	***WH58.30-Z-1003-09A**
		Charging current below desired value: ? • Check diodes for alternator (G2).	**AR15.40-P-9301-02EA**
		Engine tester with oscilloscope	***WH58.30-Z-1046-13A**
		If diodes are faulty: ? • Replace alternator (G2)	
		Engines 111, 112, 113	**AR15.40-P-5032GH**
		Engine 612	AR15.40-P-5032GI
		Engine 628 with water-cooled alternator (G2)	AR15.40-P-5032IA
		Engine 628 with air-cooled alternator (G2)	AR15.40-P-5032GD
5	Turn off engine		
6	Disconnect volt ampere tester (079) with current	[i] Volt ampere tester with load resistance	***WH58.30-Z-1002-09A**

	clamp (065)	[i] Volt ampere tester ETT 011.00	***WH58.30-Z-1003-09A**

Check values for alternator

Number	Designation			Engine 111 in models 163, 203 Engine 111 in models 202, 208 with code 910 Bosch/ Valeo	Engine 612 in models 163,203, 209, 210, 463 Delphi
BE15.40-P-1001-01A	Charging current of alternator	max.	A	120	190
		min.	A	90	150
		Engine speed	rpm	2500	2500
		Ratio	I=	2.93	2.53

Check values for alternator

Number	Designation			Engine 628.963 in model 163 NF 14V 150A	Engine 628.963 in model 163 E10 14V 90-200A
BE15.40-P-1001-01J	Charging current of alternator	max.	A	150	200
		min.	A	120	160
		Engine speed	rpm	2500	2500
		Ratio	I=	2.8	2.93

Check values for alternator

Number	Designation			Engine 112 in models 163, 170, 202, 203, 208, 209, in model 210 without code 978, in model 211 without code 910, Bosch/Valeo	Engine 113 in models 163,171,203,208, 209,210,211,215, 219, 220, 230 except models 211.076/276, 215.374, 219.376, 220.074/174, 230.472/474 Bosch
BE15.40-P-1001-01K	Charging current of alternator	max.	A	120	150
		min	A	90	120
		Engine speed	rpm	2500	2500
		Ratio	I=	2.93	2.93

Commercially available tools

Number	Designation
WH58.30-Z-1002-09A	Volt-amp(s) tester with load resistance (no longer available)

WH58.30-Z-1003-09A	Volt ampere tester
WH58.30-Z-1046-13A	Engine tester with oscilloscope

REMOVE AND INSTALL GENERATOR - AR15.40-P-5032GH

ENGINE 111.977, 112.942/970, 113.942/965/981 in MODEL 163

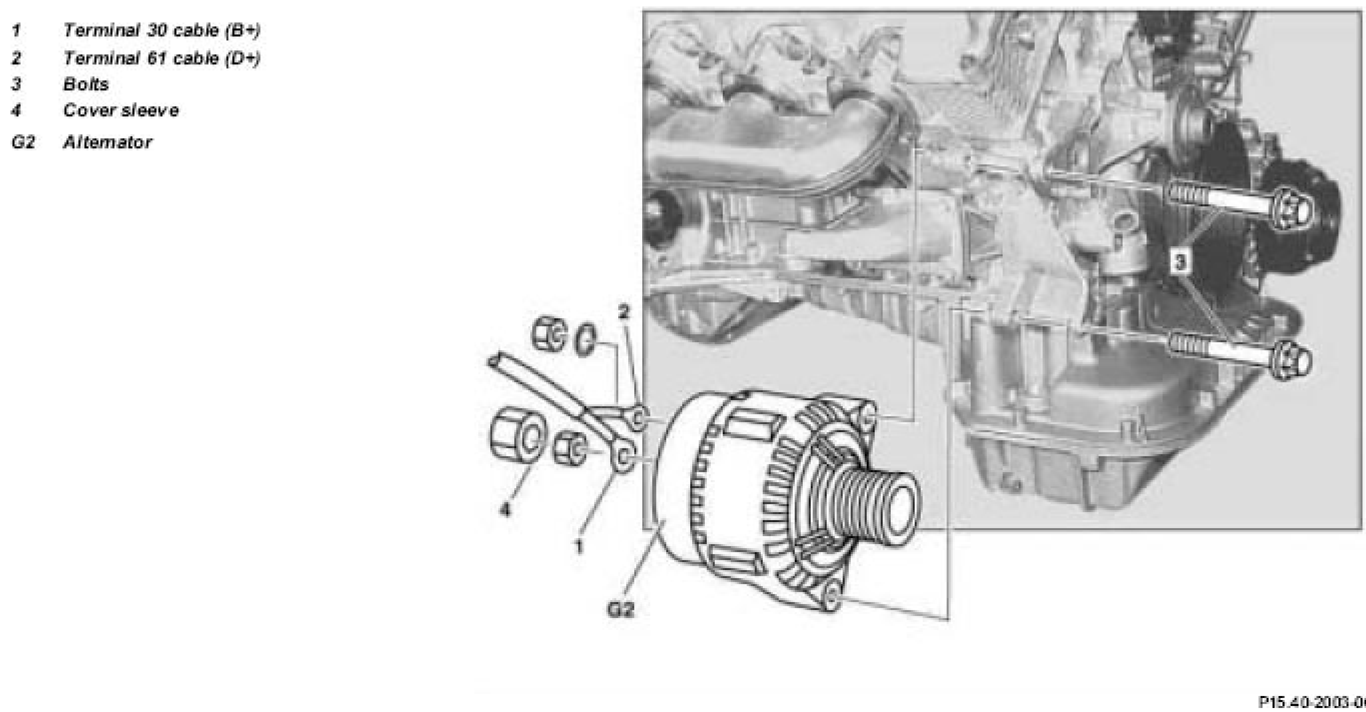


Fig. 32: Identifying Generator Remove/Install Components - Shown On Engine 112

Modification notes

14.4.00	Specification revised from 15 Nm to 18 Nm	Specification in BA15.40-P-1001-01A revised for Series 112, 113 engines	***BA15.40-P-1001-01A**
14.4.00	Value modified from 4 Nm to 5 Nm	Specification in BA15.40-P-1002-01A revised for 112, 113 engines	***BA15.40-P-1002-01A**

i	**Removal/installation**		
	Risk of poisoning caused by swallowing brake fluid. **Risk of injury** caused by brake fluid coming into contact with skin and eyes.	Fire, sparks, naked flames and smoking prohibited. Wear acid-resistant gloves, clothing and safety glasses. Pour battery acid only into suitable and appropriately marked containers.	**AS54.10-Z-0001-01A**
	Risk of injury to fingers	When moving components,	**AS00.00-Z-0011-01A**

	being jammed or squeezed when removing and installing or aligning hoods, doors, trunk lid/tailgate or sliding roof.	ensure that no body parts or limbs are within the operating range of moving parts.	
1	Open engine hood	Model 163.136/154 /172 #A up to 145272, Model 163.136 /154 /172 #X up to 708318	**AR88.40-P-1000GH**
		Model 163.136 /154 /172 #A as of 145273, Model 163.136 /154 /172 #X from 708319, Model 163.113/128 /157 /174 /175	**AR88.40-P-1000GI**
2	Disconnect battery ground line	Insulate cable lug of ground line for protection against unintentional contact of disconnected ground line.	**AR54.10-P-0003A**
⚠ Danger!	Notes on battery	All models	**AH54.10-P-0001-01A**
3	Remove air cleaner housing	**Installation:** Apply liquid lubricant to the mounting rubbers and to the connection to the air hose. Lubricant	 ***BR00.45-Z-1002-06A**
4.1	Remove engine trim panel	Engine 112, 113 only. Pull the engine cover vertically upwards and detach it from the cylinder head covers.	
5	Slacken poly V-belt	Do not remove the poly-V-belt! Engine 111	AR13.22-P-1202A
		Engine 603.931/972, Engine 113.942	**AR13.22-P-1202B**
		Engine 113.981/965	**AR13.22-P-1202BA**
6	Disconnect electrical line circuit 30 (B+) (1) and electrical line circuit 61 (D+) (2)	On engine 112, 113 take off cover sleeve (4). ⚠ Danger! ⚠ Danger!	 ***BA15.40-P-1001-01A** ***BA15.40-P-1002-01A**
7	Unscrew bolts (3) of the generator (G2)	⚠ Danger!	***BA15.40-P-1003-01A**
8	Take out generator (G2)		
9	Install in the reverse		

	sequence		
10	Perform basic programming		**AR00.19-P-0200GH**
☒	**Risk of accident** caused by vehicle starting off by itself when engine is running. **Risk of injury** caused by contusions and burns when working in engine during starting procedure	Secure vehicle to prevent it from moving. Wear closed and snug-fitting work clothes. Do not grasp hot or rotating parts.	**AS00.00-Z-0005-01A**
11	Carry out engine test run	Visual inspection of the poly-V-belt.	
12	Perform operational check		

⚠ Danger! **Alternator**

Number	Designation		Engine 111	Engine 112.91/92/94/953/954/955/96/97,113.94/96/98
BA15.40-P-1001-01A	Nut of circuit B+ to generator	Nm	15	18
BA15.40-P-1002-01A	Nut of circuit D+ to generator	Nm	4	5
BA15.40-P-1003-01A	Screw, alternator	Nm	42	42

Repair materials

Number	Designation	Order number
BR00.45-Z-1002-06A	Lubricant	A 000 989 01 60

REMOVE/INSTALL GENERATOR BELT PULLEY - AR15.40-P-5710GF

ENGINE 111.977, 112.942/970, 113.942/965/981 in MODEL 163

ENGINE 166.940 /960 in MODEL 168

ENGINE 112.923 /943, 113.961 in MODEL 129

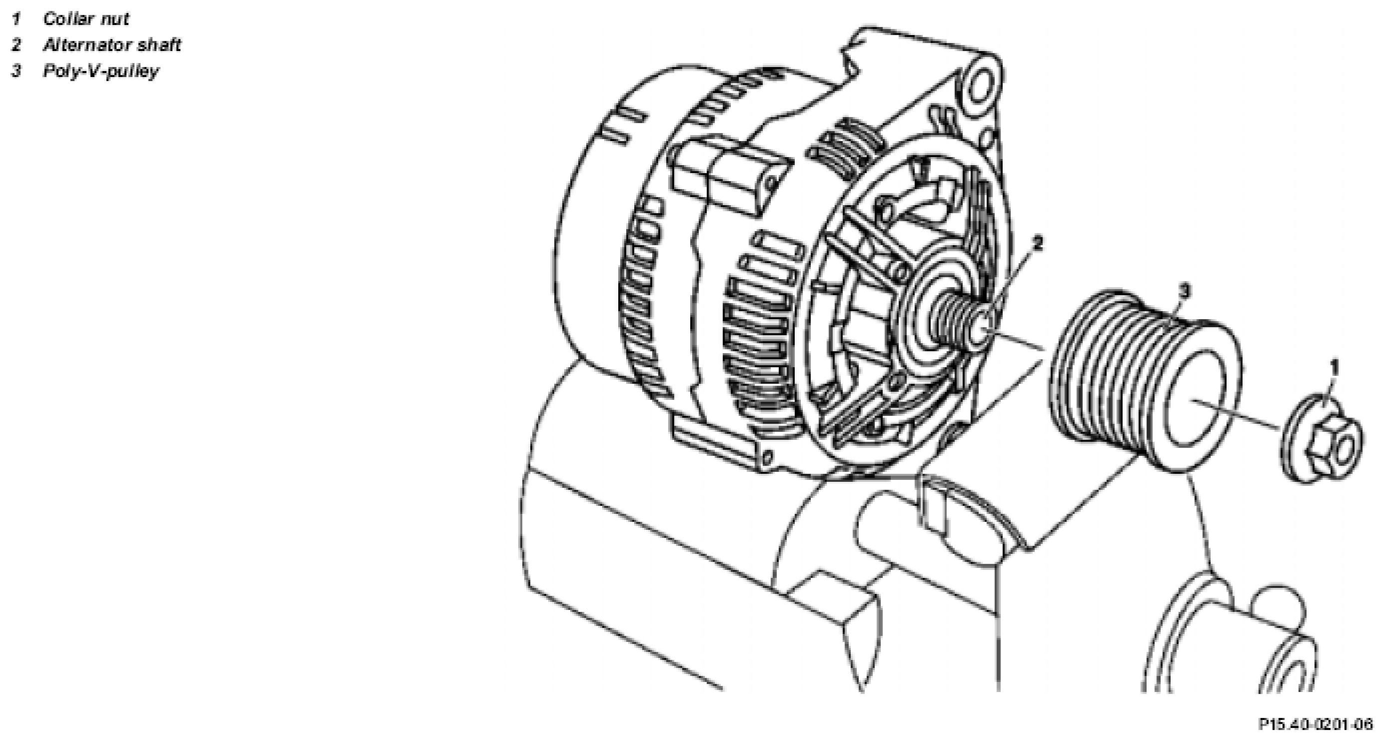


Fig. 33: Identifying Generator, Belt Pulley And Collar Nut

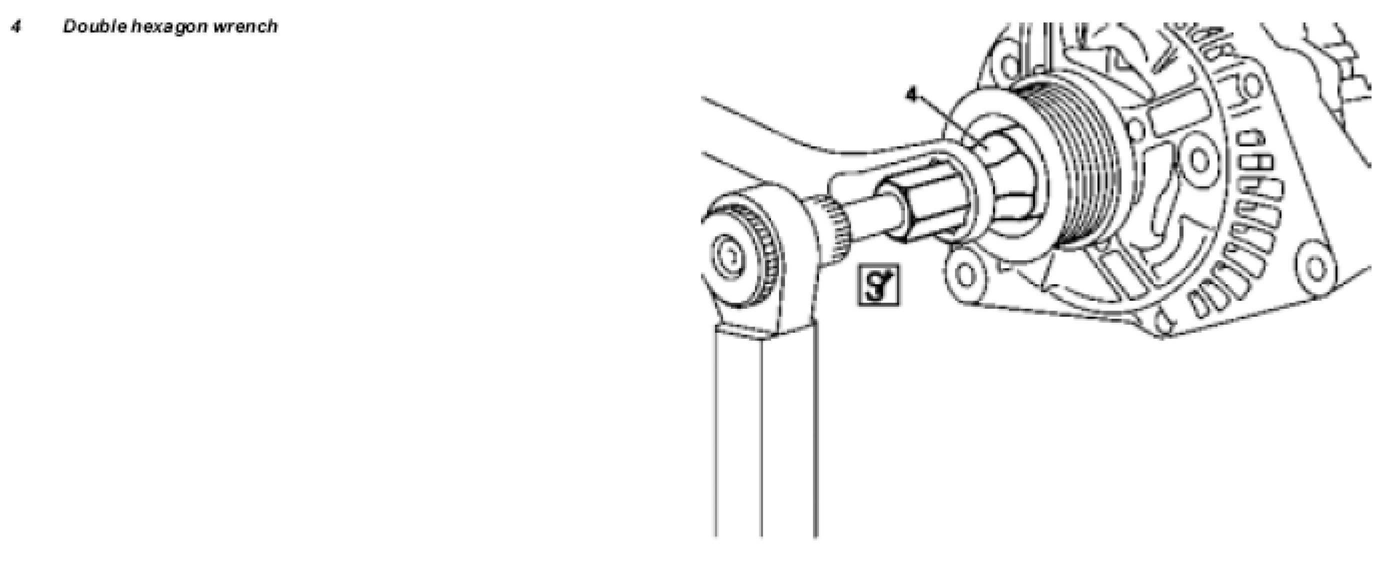


Fig. 34: Identifying Double Hexagon Wrench And Generator

	Remove/Install		
1	Remove alternator	Engine 112, 113 in Model 129. Engine 166.940 /960 in	AR15.40-P-5032CT AR15.40-P-5032GF

		Model 168. Engine 111, 112, 113 in model 163.	**AR15.40-P-5032GH**
2	Unscrew collar nut (1)	To hold generator shaft (2), insert screwdriver bit through double hexagon wrench (4).	
	Shorten double hexagon wrench to remove the belt pulley	Model 163 only Engines 111, 112, 113: ? Danger! Engine 166: ? Danger!	WF58.50-P-1540-01I ***BA15.40-P-1004-01A** ***BA15.40-P-1003-01B**
3	Remove ribbed V-belt pulley (3)	When replacing generators after mileages in excess of 100.000 km simultaneously also replace the poly-V-belt pulley (3).	
4	Install in the reverse order		

Danger! **Generator**

Number	**Designation**		**Engine 166.940/ 960**
BA15.40-P-1003-01B	Collar nut to poly V-belt pulley	Nm	80

Danger! **Generator**

Number	**Designation**		**Engine 111**	**Engine 112.91/92/94/ 953/954/955/ 96/97, 113.94/96/98**
BA15.40-P-1004-01A	Collar nut to poly V-belt pulley	Nm	80	80

REMOVE/INSTALL REGULATOR OF ALTERNATOR - AR15.40-P-5760GH

ENGINE 111.977, 112.942/970, 113.942/965/981 in MODEL 163

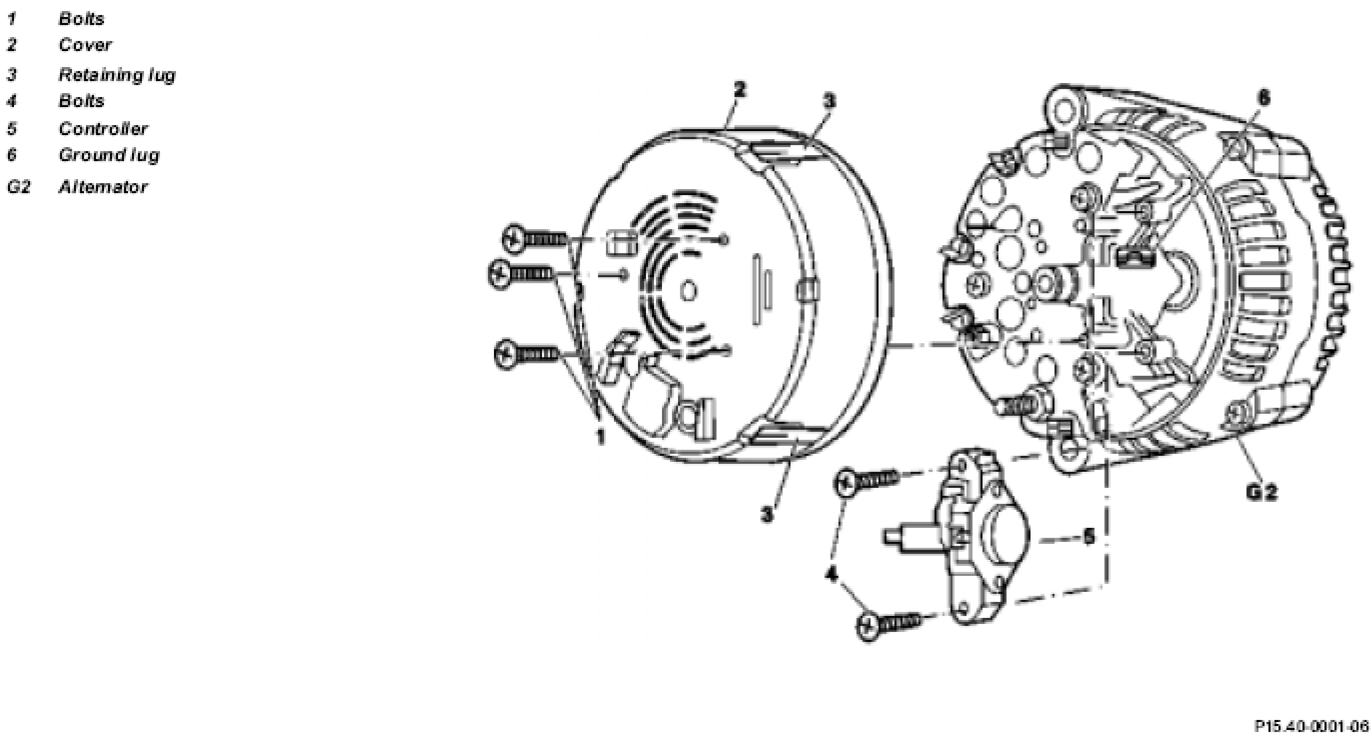


Fig. 35: Identifying Alternator Regulator Remove/Install Components

Modification notes

26.4.05	Remove alternator omitted Remove the right fender liner in the front fender added Remove heat shield added	 Step 1 Step 2	

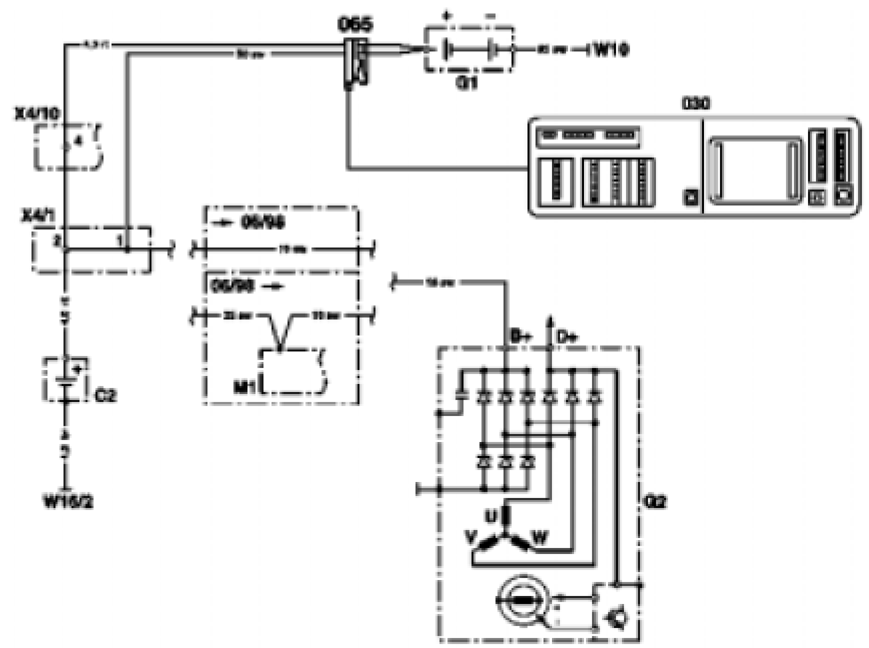
	Remove/Install		
1	Remove right inner fender in front fender		**AR88.10-P-1300GH**
2	Remove the heat shield over the alternator		
3	Unscrew bolts (1)		
4	Unclip cover (2) and remove	Push apart retaining lugs (3).	
5	Remove screws (4).		
6	Remove regulator (5) towards the side	**Installation:** When inserting the governor (5) ensure, that the ground lug (6) sits close to the governor (5).	
7	Install in the reverse order		

TEST DIODES OF GENERATOR - AR15.40-P-9301-02EA

Commercially available tools

Number	Designation
WH58.30-Z-1046-13A	Engine tester with oscilloscope

030	*Engine tester with oscilloscope*
065	*D.c. clamp*
C2	*Electrolytic capacitor (alternator/ battery harness noise suppressor)*
G1	*Battery*
G2	*Generator*
M1	*Starter*
W10	*Ground (battery)*
W16/2	*Major assemblies compartment ground (electrolytic capacitor, noise suppression generator/battery line*
X4/1	*Terminal block (circuit 30 , interior)*
X4/10	*Terminal block (circuit 30/30Ü/61e/87L) (6-pin)*
br	*Brown*
rt	*Red*
sw	*Black*

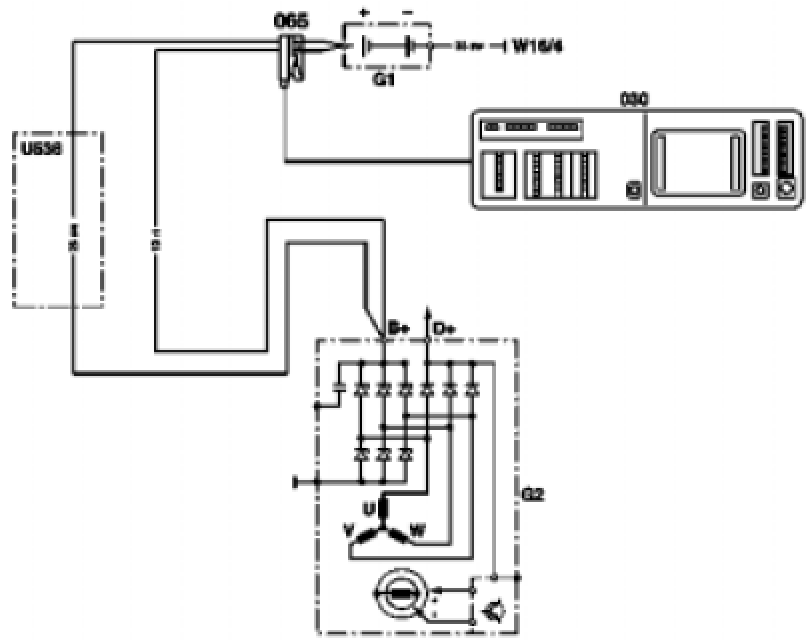


P15.40-2066-06

Fig. 36: Generator Connection Diagram - Model 129

Ⓘ Model 129 with engine 119 up to vehicle ident end no. 1F 032 589: Problems with power supply system - test battery voltage-dependent idle speed increase (refer to Diagnosis Manual Engine Volume 2 Group 07.3).

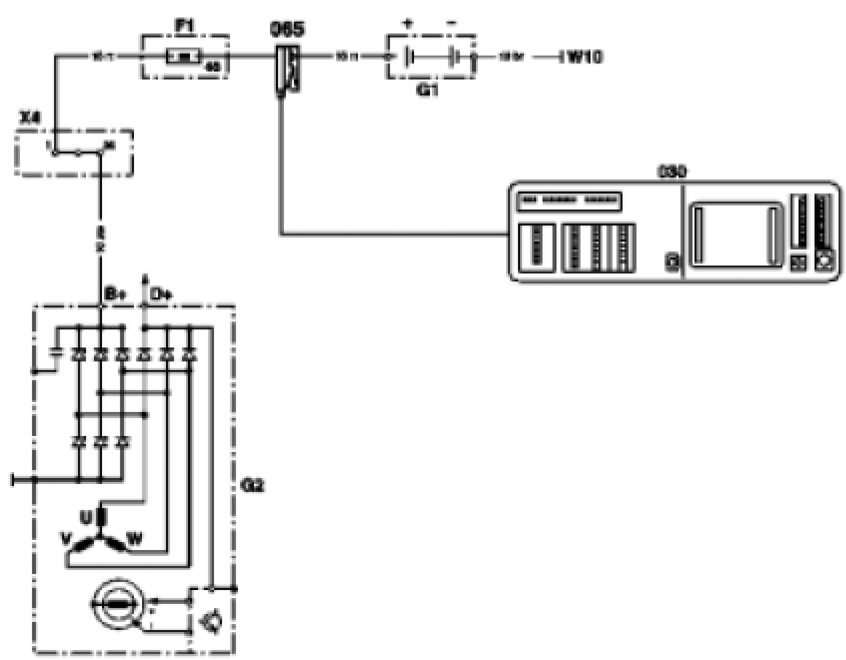
030	*Engine tester with oscilloscope*
065	*D.c. clamp*
G1	*Battery*
G2	*Generator*
U536	*Valid for engines 112/113*
W16/4	*Ground (output ground - major assemblies compartment - right)*
rt	*Red*
sw	*Black*



P15.40-2060-06

Fig. 37: Generator Connection Diagram - Model 163

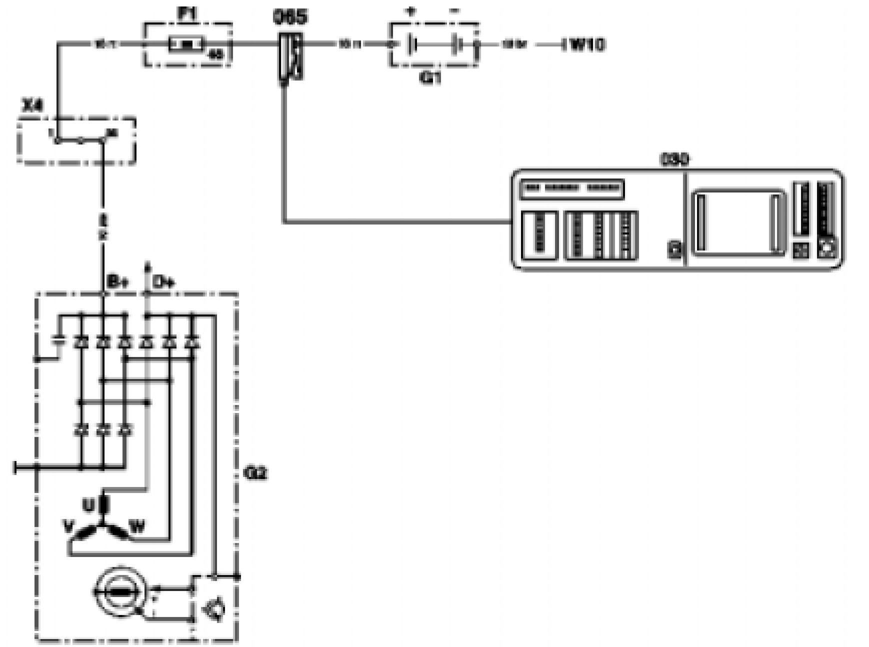
030	*Engine tester with oscilloscope*
065	*D.c. clamp*
46	*Fuse 46*
F1	*Fuse and relay box*
G1	*Battery*
G2	*Generator*
W10	*Ground (battery)*
X4	*Terminal block circuit 30, fuse and relay box/interior, 2-pin*
br	*Brown*
rt	*Red*
sw	*Black*



P15.40-2063-06

Fig. 38: Generator Connection Diagram - Model 168

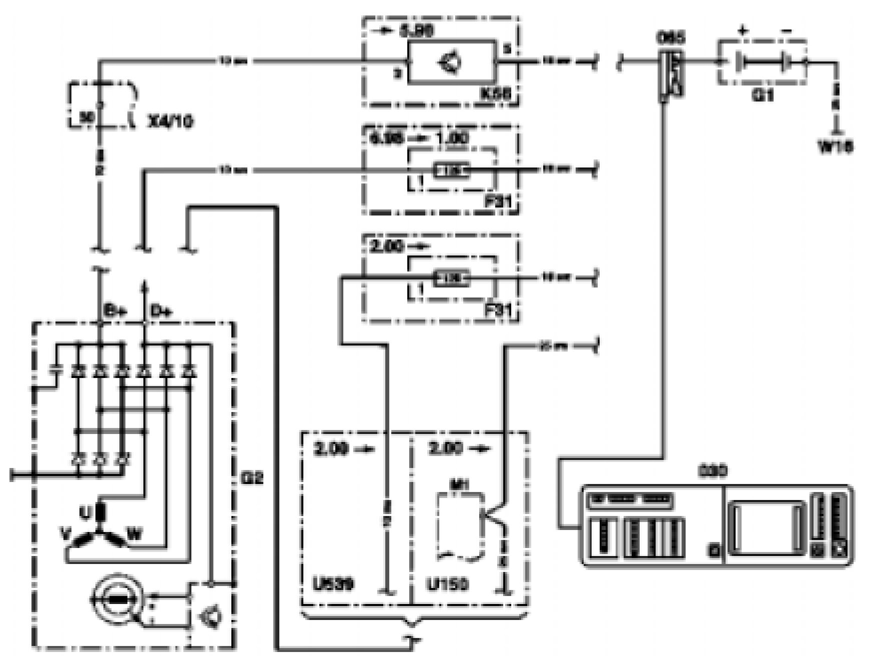
030	*Engine tester with oscilloscope*
065	*D.c. clamp*
46	*Fuse 46*
F1	*Fuse and relay box*
G1	*Battery*
G2	*Generator*
W10	*Ground, battery center console (interior)*
br	*Brown*
rt	*Red*
sw	*Black*



P15.40-2063-06

Fig. 39: Generator Connection Diagram - Model 414

030	*Engine tester with oscilloscope*
065	*D.c. clamp*
1	*Fuse 1 (alternator terminal 30)*
F31	*Battery fuse box*
G1	*Battery*
G2	*Generator*
K56	*Crash shut-off relay (generator/ battery)*
M1	*Starter*
U150	*Valid for engine 112*
U539	*Valid for engine 111 ME-SFI*
W16	*Ground (component compartment)*
X4/10	*Terminal block (circuit 30 and circuit 61 at battery) (3-pin)*
sw	*Black*



P15.40-2089-06

Fig. 40: Generator Connection Diagram - Model 170

030	*Engine tester with oscilloscope*
065	*D.c. clamp*
G1	*Battery*
G2	*Generator*
M1	*Starter*
U549	*Valid for all except M112*
W10	*Ground (battery)*
X4	*Terminal block (circuit 30, left footwell)*
X12/3	*Terminal block circuit 30/15 unfused, 3-pin*
rt	*Red*
sw	*Black*

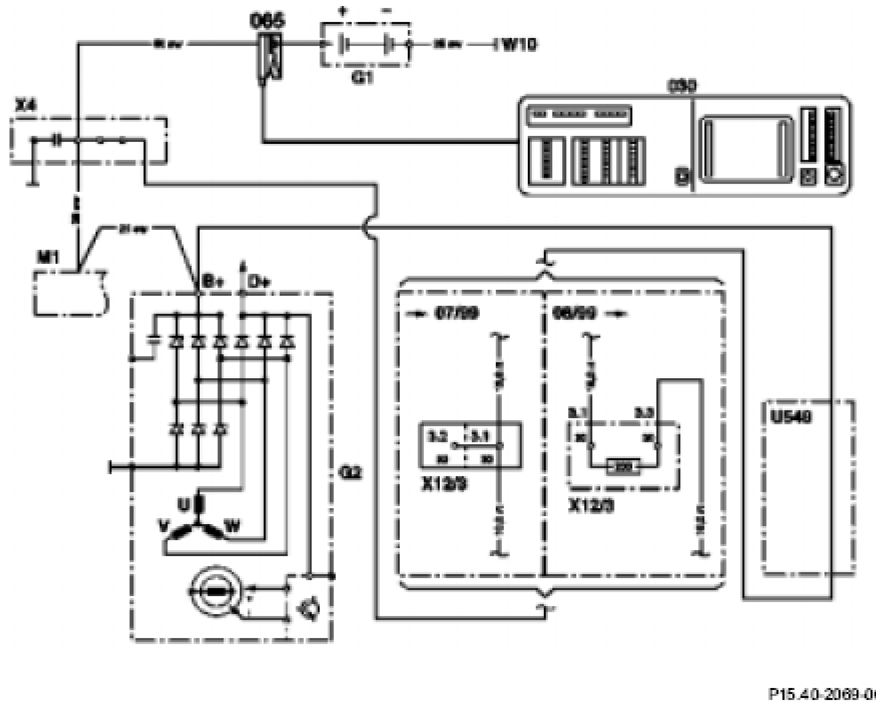


Fig. 41: Generator Connection Diagram - Model 202

030	*Engine tester with oscilloscope*
065	*D.c. clamp*
G1	*Battery*
G2	*Generator*
M1	*Starter*
U549	*Valid for all except M112*
W10	*Ground (battery)*
X4	*Terminal block (circuit 30, left footwell)*
X12/3	*Terminal block (circuit 30)*
rt	*Red*
sw	*Black*

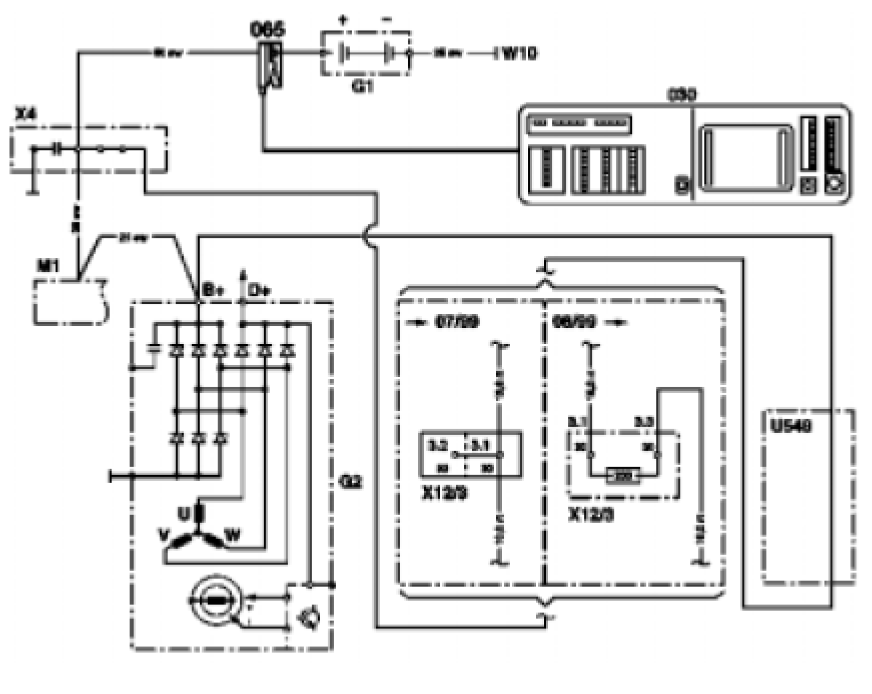
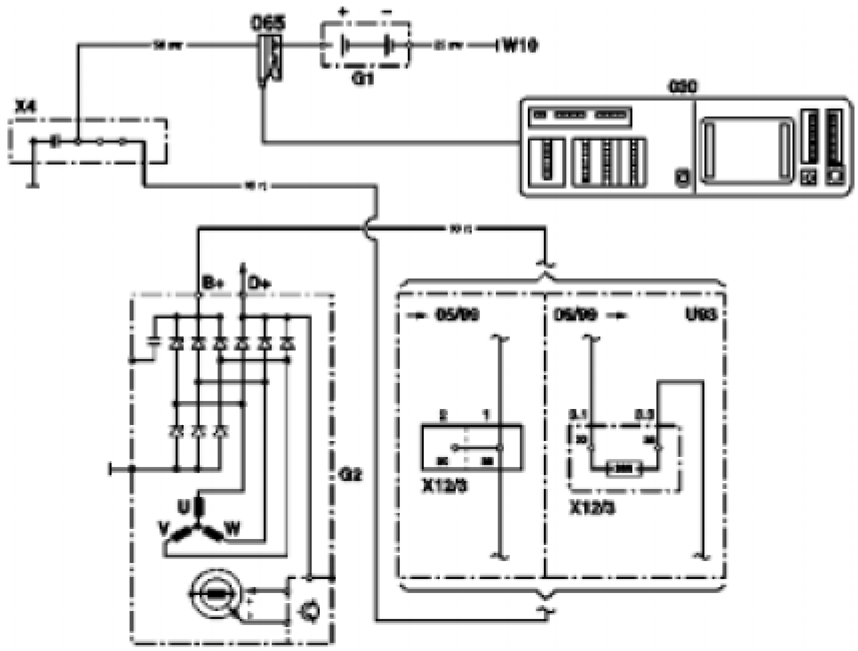


Fig. 42: Generator Connection Diagram - Model 208

Model 210: as of 1.6.99 a fuse for protection of generator is located in the terminal block circuit 30 (X12/3).

030	*Engine tester with oscilloscope*
065	*D.c. clamp*
G1	*Battery*
G2	*Generator*
U93	*Valid for in-line engines*
W10	*Ground (battery)*
X4	*Terminal block (circuit 30, left footwell)*
rt	*Red*
sw	*Black*

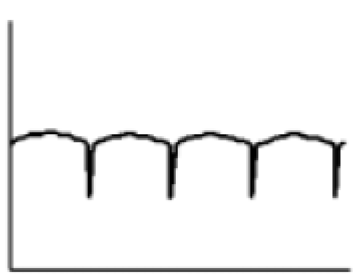


P15.40-2077-06

Fig. 43: Generator Connection Diagram - Model 210

1. Connect DC clip-on probe (065) from engine tester with oscilloscope (030) to positive pole of battery (G1)
2. Start engine.
3. Switch on low beam.
4. Assess diode harmonics at 3000 rpm (engine speed).

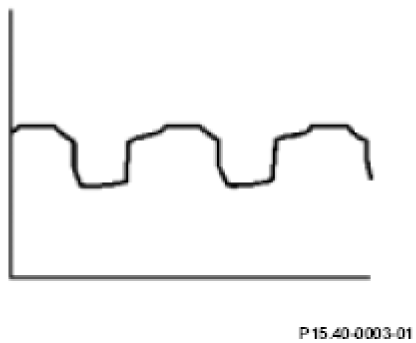
ⓘ In this test it is not possible to assess the exciter diodes.



P15.40-0002-01

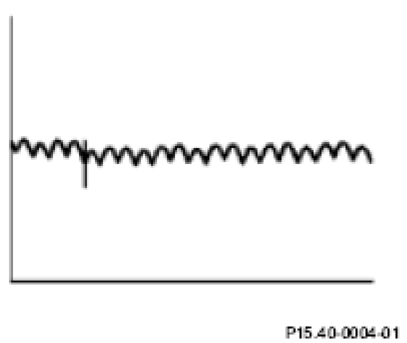
Harmonics if a negative diode is defective (example).

Fig. 44: Identifying Harmonics - Negative Diode Defective



Harmonics if a positive diode is defective (example).

Fig. 45: Identifying Harmonics - Positive Diode Defective



Diode harmonics OK (voltage spikes possible but not important) (example).

Fig. 46: Identifying Diode Harmonics OK

REPLACE SPARK PLUGS - AP15.10-P-1580GH

ENGINE 112.942 in MODEL 163.154

ENGINE 112.970 in MODEL 163.157

ENGINE 113.942 in MODEL 163.172

ENGINE 113.981 in MODEL 163.174

ENGINE 113.965 in MODEL 163.175

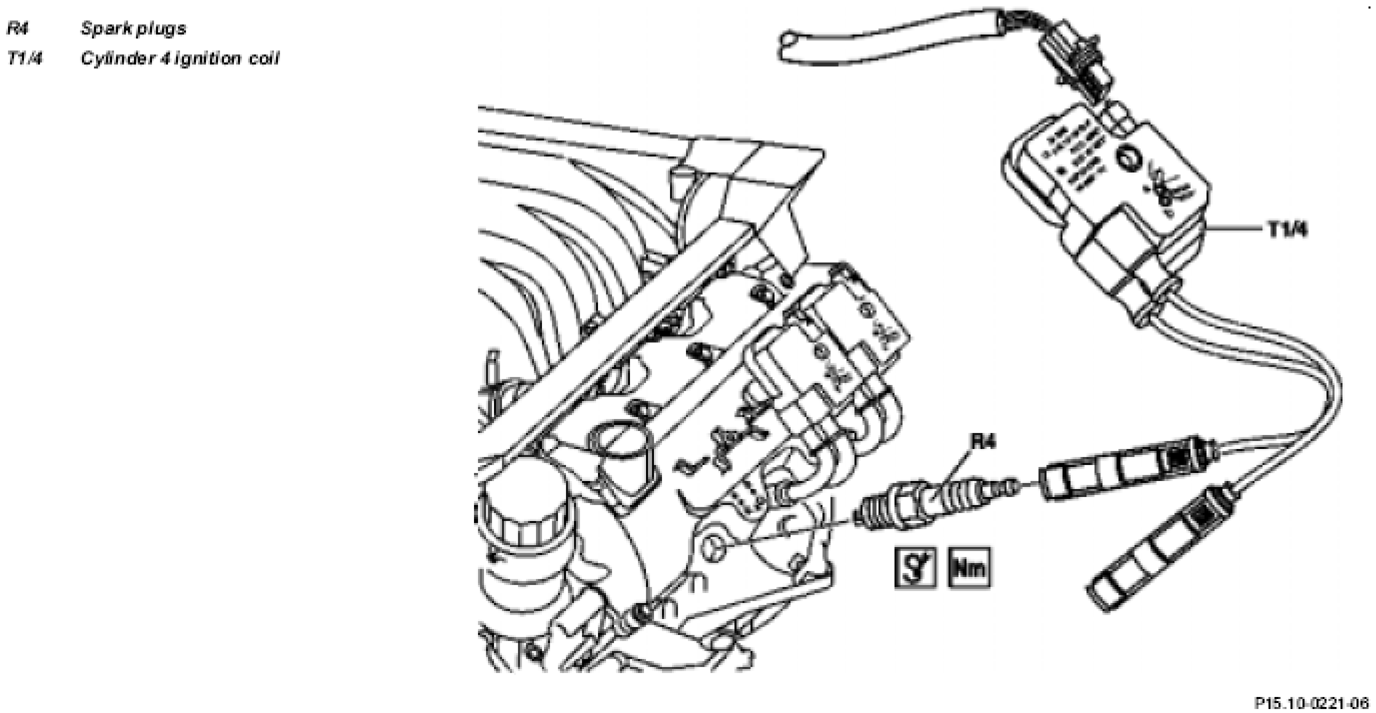


Fig. 47: Identifying Spark Plugs And Cylinder 4 Ignition Coil

	Remove/install and replacing		
	Risk of death due to contact with high-voltage conductive parts	Do not touch parts which conduct high voltages. Persons who are carriers of electronic implants (e.g. cardiac pacemaker) may not carry out any work on the ignition system	**AS15.10-Z-0001-01A**
Danger!	Notes on avoiding damage to ignition system	Engine 104, 111, 112, 113, 119, 120,271	**AH15.10-P-0002-01D**
1	Remove/install air filter upper section		
2	Remove ignition coils Remove/install ignition coils		**AR15.12-P-2003A**
3	Disconnect spark plug connectors	Prise over cylinder head cover. Double open-ended wrench	**Fig. 24**
	Checking		
4	Check spark plug	Replace, if necessary.	

	connectors, ignition coil connectors and ignition lines for damage, deformation and crack formation		
5	Remove/install spark plugs (R4)	⚠ Danger! Spark plug wrench	***BA15.10-P-1001-01A** **Fig. 48**

⚠ Danger! **Spark plugs**

Number	**Designation**		**Engine 104,110,111, 113.940/941/942/943/ 944/948/960/961/962/ 963/964/965/966/967/ 968/969/971/980/981/ 982/984/986/992/993/ 995,115,117,119, 120**	**Engines 112.910/911/ 912/913/914/ 915/916/917/ 920/921/922/ 923/940/941/ 942/943/944/ 945/946/947/ 949/951/953/ 954/955/960/ 961/970/972/ 973/975/976**
BA15.10-P-1001-01A	Spark plugs	Nm	28	28

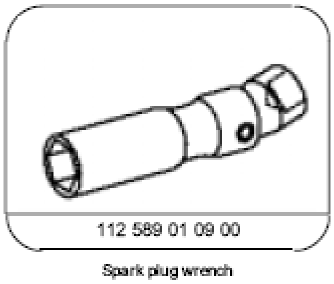


Fig. 48: Identifying Spark Plug Wrench (112 589 01 09 00)

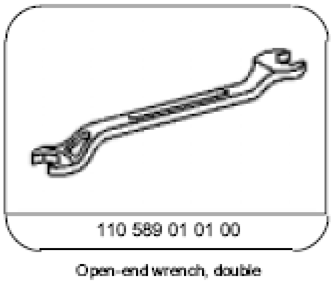


Fig. 49: Identifying Open-End Wrench, Double (110 589 01 01 00)